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THE ENGINEERING SOCIETIES BUILDING.

A notable stage in the joint engineering building project was reached last week, when at the invitation of the United Engineering Society, the councils of the three national bodies met in the building to inspect it, and then enjoyed an informal banquet in one of the auditoriums. The stately simplicity and dignity of the building won instant approval, its many conveniences and facilities were admired, and the fact that it had been erected within the contract time and the appropriation brought well-deserved praise to the conference committee and the architects. As we write various societies are on the move to occupy their offices, and the formal dedicatory exercises are set for April.

Perhaps best of all is the news as to the progress in raising the money necessary to pay for the land on which the Carnegie gift stands—a sum of over $500,000. Last week, in keeping with other donations, Mr. George Westinghouse announced for himself and associates the largest contribution so far made—viz., $50,000—to the funds of the three founder societies in equal shares. The Electricals now have pledges of over $150,000, with $100,000 collected; the Mechanicals and Mining Engineers have each $100,000, so that the end is fairly well in sight. After a year or two all three bodies will be in better financial condition than ever before, and in the new home will be able to prosecute their professional work to the fullest advantage. Equally well situated as to the enhanced conditions of usefulness will be the associated societies that with their thousands of members become co-tenants of this splendid building—the finest center of engineering effort in the world.

NEW TYPES OF INCANDESCENT LAMPS.

The paper which immediately followed that of Dr. Steinmetz, at the last meeting of the A. I. E. E., gave a detailed description by Dr. Clayton H. Sharp of various recent tests of tungsten, tantalum and graphite-filament lamps. In regard to the tantalum filament, it was clearly shown that its probable lifetime is so greatly reduced by alternating currents at a frequency of 60 cycles per second, that it may be considered at present as distinctively a direct-current type of incandescent lamp. Curiously enough, the tantalum filament is the only one known to be drawn down through dies; or to possess sufficient ductility to permit of such a process. Whether the crystallization that appears to occur in the filament with age in service, and especially rapidly in alternating-current service, is connected with this ductility, it would be interesting to ascertain. One great practical advantage with tungsten filaments is that they have no smashing point. They die of old age, but not by the blow of the executioner's hammer for feebleness in service. The carbon lamp is supposed theoretically never to die in harness, but to be taken off the mains before it breaks, unless there has been a defect in its filament. A lamp that calls for no renewal until it ceases to operate has a marked advantage in practice. It must be remembered, however, that if the efficiency of tungsten lamps should be carried beyond 1 spherical candle-per-watt, we may look for an increased accompanying evaporation of the filament and consequent darkening of the bulb. The fact that these lamps have

no smashing point is an indication of margin between their present working temperature and the temperature of rapid evaporation.

Interesting oscillographs of the current rise in carbon and tungsten lamps showed that, under the conditions of the measurement, the initial current in the tungsten lamp was nearly four times the subsequent steady current of operation. The ratio of starting current to full-load current of operation is therefore worse for a metallic-filament lamp than for an induction motor, but the period of transition to full-load operation is only a fraction of a second in the case of the lamp, as against several or many seconds in the motor. Nevertheless, it is possible that the turning on of large groups of tungsten lamps simultaneously may cause a more visible flicker or winking of such lamps as are already connected to the mains, than with the carbon-filament lamps of to-day, in spite of the reduced sensitiveness of a tungsten lamp to changes of voltage.

The Transformation of Electric Power into Light.

The paper read by Dr. Steinmetz upon this subject, last week, before the American Institute of Electrical Engineers, and printed elsewhere in abstract, contains many points of interest, both theoretical and practical. When the incandescent lamp became securely established commercially on the basis of a 100-volt carbon filament, it became evident that although the incandescent lamp, at an efficiency of ⅓ spherical candle-per-watt, was much more convenient than an arc-lamp, yet the arc-lamp was a considerably more effective device for converting electric power into light. The arc-lamp at that time developed an efficiency of about 1 spherical candle per watt. For ten or more years, very little improvement took place in the efficiency of either of these lamps. The incandescent lamp was steadily improved in life-duration and cheapness. But its efficiency was only advanced to about ¼ spherical candle per watt. Recently, however, great strides have been made, both in arc lamps and in incandescent lamps, for increasing their effectiveness as light producers. The directions along which the advance has taken place is outlined in the paper referred to.

Both the arc and incandescent carbon lamps of twenty years ago depended upon the temperature of an electrically-heated mass of carbon. In the arc, nearly all the light was produced at the surface of the crater in the positive carbon, where the carbon boiled away, or was raised to its temperature of ebullition. In the incandescent lamp, the temperature had to be kept well below the melting point of carbon. Moreover, the evaporation of carbon from the incandescing filament, under the stimulus of electric potential difference, takes place rapidly at temperatures even well below the melting point of carbon, with a consequent rapid blackening of the internal surface of the glass bulb. The working absolute temperature of the incandescent carbon filament could thus only be made about one-half that of the absolute temperature of boiling carbon under ordinary pressures of the air. It was well known that the luminous efficiency of an electrically-heated solid increased rapidly with the temperature of the light-producing surface, and, therefore, few hopes were entertained of the incandescent filament coming into effective competition with the arc-lamp on the basis of efficiency, whatever might be its relative advantages in convenience, light, sub-division or other qualities.

The arc lamp has recently been greatly developed as an illuminant by increasing the radiative powers of the arc-flame. This is done either by the use of a cathode, such as magnetite, which gives off a highly luminous discharge, or by the use of a calcium salt in the anode carbon which becomes raised to the boiling temperature by cathode-particle bombardment, and which evaporates off the highly luminous calcium vapors into the flame. In either case the increased luminous efficiency has not been due to an increased temperature, but to the introduction into the arc of a gaseous substance which has the property of luminescence, or shining, presumably by vibrations within the compass of single atoms, when raised to a suitable temperature. The temperature of luminescence of a gas may be very low, whereas the temperature of efficient incandescence of a solid must be very high. On the other hand, the incandescent lamp has undergone marked improvement of late, owing to the substitution of a refractory metal for carbon in the filament. With tungsten, the efficiency has already been raised to 0.7 spherical candle per watt, and there are hopes of bringing this up to 1 spherical candle-per-watt before very long. It is stated that at the melting point of tungsten its efficiency is nearly 5 spherical candles-per-watt. The advance with osmium, tantalum and tungsten lamps is mainly to be attributed to the increase in working temperature.

We now find the incandescent lamp in competition with the arc lamp in luminous efficiency. The race between them has, however, completely changed in character. The hope for incandescent filaments is, at present, nearly limited to raising the working temperature, or approaching that of the solar surface. The hope for arc lamps lies in the direction of lowering the temperature or approaching that of a fire-fly's tail. If the search for luminescent substances that can be stirred up into atomic vibration by electric means is successful, the incandescent lamp must be defeated, because, so far as can be seen at present, the efficiency of an incandescent body must be relatively small, even if we could work the body at the temperature of the sun. On the other hand, if we could discover a luminescent gas that could be excited electrically into subatomic vibration without being heated appreciably—that is, without increasing the average speed of its molecules—there is no reason in sight for setting a low limit to the luminous efficiency. We might, however, find the color of the luminescence depart considerably from that of ordinary sunlight. Already, then, we find the temperature of the most improved incandescent filaments climbing up, while that of the more efficient mercury arc has come down.

The Small Central Station.

We published recently in the Digest an abstract of a paper by Dr. Dettmar on the financial returns from small central stations, which contains data that American station men may well take to heart. Of course, there is a very general sentiment in financial circles against small plants as investments, perhaps ascribable to small opportunity for promotion in part, but based also upon sad experience. Yet small places want modern improvements and it is a demonstrable fact that some small stations do pay a reasonable and sometimes liberal return on the investment. German towns, like American ones, show both good and bad results. Dr. Dettmar classifies as bad all plants which do not show at least 8 per cent of gross earnings on the capital invested, the gross earnings being the receipts less the full operating and maintenance charges, including all salaries. Of 64 electric plants in places of 1,000 to 5,000 population investigated by Dr. Dettmar, just one-half fell into the "good" category, and of this number 17 showed gross earnings better than 10 per

cent. One must bear in mind that even 10 per cent reckoned as gross earnings would not be considered a satisfactory return upon the investment in this country unless the conditions of growth were promising; but since some prospectively "good" plants would probably be found in the "bad" column it may be within proper bounds to say that a quarter of the plants reported are to be considered as good investments. The question to be solved is the cause of the unhappy status of the rest. As nearly as can be judged, the largest factor in the answer is, as would be the case in American towns, good judgment in proportioning the cost to fit the cloth.

The absolute population of the place appears to have only a minor effect on the result, since the 17 plants on better than a 10 per cent basis included both the largest but one (4,800) and the smallest (1,200) towns in the whole list. It is in the investment per capita that one begins to reach significant facts. The average for the whole list is $12, while only one of the 17 exceeds this figure and only by $1 at that. In the list of "bad" plants one finds many cases of $15 to $20 investment per capita. The receipts per capita in the successful plants are not conspicuously high, the average for the group being less than 11 cents per annum per capita above the average for the whole 64. The successful plants then do not owe their fortune to being in selected places where the sales of energy are abnormally large so much as to rigorous keeping down of capital and current charges. Of course, in such a list of plants one would expect to find very great variations in the distribution of expenses, and such is the case. In the successful plants, however, the wage and salary account is, on the whole, notably small as compared with the general operating account. One cannot make too much of this difference, since the ratio would be small also were the operating expenses abnormal, as appears in some of the plants considered. But the wage and salary account in the profitable plant is certainly very small compared with that in American plants under similar conditions, smaller in fact that mere difference in rate of wages would suggest. For instance, the total wages and salary account of one plant in a town of 4,500 people, which made gross earnings of a little over 16 per cent on an investment of about $4,500, amounted to only $900. It is difficult to grasp the meaning of these figures, even realizing German wages. They imply both a small force and a very efficient one at very low wages. A plant like the one just mentioned could not be run in this country even on the most economical basis for less than twice the figure given. It is, however, by no means the lowest on Dr. Dettmar's list. A factor perhaps important in these low labor costs is the relatively compact character of most German towns of the size considered.

To examine another phase of the matter Dr. Dettmar gives tables covering the results obtained in a group of cities of 10,000 to 20,000 inhabitants. These form a class in which American experience would indicate the possibility of fair returns when the enterprise is economically carried on. Taking average figures only, the class shows only 60 per cent of the investment per capita found in the smaller towns, relatively less wages and salary account and somewhat diminished sales per capita, which averaged about $1.25 annually as against about $1.87 for the smaller towns. This discrepancy is only in part explained by the competition from gas, which is the rule in the former case. The average return in the larger places tabulated is above 10 per cent gross on the same basis as before. The relatively less labor cost in the larger plants is a considerable advantage. Fancy an American electric light station in a city of 16,000 inhabitants running on a total wages and salary list of $20,000 per year! Here, again, one gets a strong impression from Dr. Dettmar's figures that in many of the cities considered the actual distribution is much less extensive than usual here. Certainly a capital account of $3.75 per inhabitant does not indicate any great similarity with American conditions. For this reason we are inclined to attach little importance to any comparison of actual figures as between German and American plants. If the former find it rather hard to exist in small places, the latter must have a still worse time of it. Yet the same conditions make for success in both countries; a community where the working area is small and the demand good, a plant planned with rigid economy as a permanent investment, a small and efficient force—all these things co-operate for success. There are certainly plants in small American towns which bring fair returns, and in practically every instance they will be found to be one, two or three-man plants built practically as private investments and operated as such. On an American wage scale few plants in Dr. Dettmar's list would pay 10 per cent, but still there are a few. One of the most serious features of the labor problem in these plants is the difficulty of hiring fractional men, and the suggestion of deliberately finding suitable occupation for the men needed for but a few hours per day is interesting, although somewhat impracticable here. What wouldn't the unions do to the hapless chap who should happen to try it? The final solution in the case of many small plants will be their relegation to the duty of substations supplied with power from a large central generating station. The distribution of current over a radius of 50 miles presents, at the present time, less of a problem than did the distribution of current by a small plant in some towns fifteen years ago. The rise of district supply and local distribution has been slow in this country, but its day is not now far distant. When it comes, the present central station organizations of small towns will be transformed to purely commercial ones, their present engineering functions being taken over in toto by the central generating plant.

ELECTRIC VERSUS OTHER FIRE HAZARDS.

More intelligent, systematic and scientific attention has probably been given to the reduction of fire risks due to electric wiring and apparatus than to any other class of fire risks. This is due not to the serious nature of electric risks as compared with others, but because the improvement of standards of electrical installation calls for a higher degree of technical skill than the plain every-day precautions necessary to keep down fire risks, such as those connected with defective chimneys, overheated stoves and the numerous other common causes of fires. With numerous technical men analyzing causes from electrical fires and striving to reduce them, it has been but natural that the reduction of the electrical fire risk has been given more scientific and careful attention than other risks. It is fortunate for the electrical industry that this has been so and that the rules for electrical installations are as rigid as they are. It would be a great calamity to the electrical business as a whole should the National Electrical Code and inspection be wiped out of existence. We fear sometimes, however, that this very vigilance in regard to the electrical fire hazard has magnified its relative importance, both in the eyes of insurance men and of the public generally, and that when it comes to a case of an electrical risk versus some other kind of risk, the comparative safety of the electrical risk is not given its due share of credit. As an illustration of this point a case may be cited in a city where a considerable number of 500-

volt stationary motors were being operated from a circuit supplied from the bus-bars of a street railway power house. One side of the circuit was, of course, grounded. Now this is one of the things that is prohibited in big type in the National Electrical Code. The insurance inspectors in due course of time pounced on these motors. The motors, however, are still in service and the insurance opposition has been quietly withdrawn for the simple reason that most of them are in locations to which the power supplying company could not afford to run any other circuit, and if the motors were removed it would be a case of taking out a motor operated on a well-installed grounded circuit and putting in a gasoline engine. We do not know of anything which better illustrates the fact that while we are talking about electrical fire risks we should at the same time consider the other risks which would take their place if the electrical risk were removed. We should very much like to see the whole subject of fire hazards from various sources gone into more thoroughly by insurance interests. It is certain that this will be done as time goes on, as progress is being made in this direction, and it is equally certain that electrical interests will be the gainer thereby.

Take for example the figures given elsewhere from the Ohio Fire Commissioner's report for 1905 showing the causes of fires in Ohio. We are not aware that any such strenuous efforts are being made to prevent the installation of defective flues and chimneys (which are the most prolific sources of dwelling house fires) as are being made to prevent the installation of defective electric wiring. Nor have we heard that any such precautions are taken to insure the proper location of stoves and furnaces as are being taken to prevent the improper location of electric rheostats. We are glad, as said before, that electrical inspection is being as well looked after as it is, because it is keeping down the electrical fire hazard and putting electricity in good repute. Nevertheless, as stated before, it is a question whether this very vigilance to prevent defective electrical work as compared with the laxity of inspecting other hazards does not lead to a failure to give electricity due credit for its safety.

Direct-Current Switchboard Design.

The article in this issue on recent advances in direct-current switchboard design by Mr. Edward Schildhauer, describing and illustrating the recent practice of the Chicago central station companies, shows in a striking way what advances in simplicity and reliability have been made in direct-current switchboard design even in the past few years after the design of such switchboard had supposedly become fairly settled. A comparison of the latest construction described by Mr. Schildhauer with boards built as recently as five years ago, makes the older constructions seem complicated and but poorly protected against possible accidents. The most distinctive feature of the new construction is the placing of bus-bars leaves horizontally. Besides this the construction is the result of a number of years of evolution in protecting cables better and getting them into tile ducts as soon as possible after they leave the bus-bars, leaving a minimum amount of exposed conductors. As Mr. Schildhauer remarks, the design of alternating-current switchboards has attracted so much attention during the past few years because of the newness of alternating-current development, that the design of direct-current switchboards has been passed by as a settled practice.

Billboard Lighting.

A class of display work which has not been worked up to any extent by central station companies and which is nevertheless as profitable as any other class of flat-rate sign and display lighting, is that of illuminating billboards at night according to the plan which is being carried out by the central station company at St. Louis, as described in our issue of August 11, 1906. The billboard companies while at first opposing this innovation, have apparently come to see that it is really a means for increasing the efficiency of this class of advertising by adding to the number of hours it is in service. A billboard which otherwise would be of no use after dark is changed into a good advertisement for the whole evening. In fact, at the present stage of the game, an illuminated billboard will attract much more attention by night than by day. The best method of billboard lighting yet introduced is by rows of conical metal reflectors at the top of the board, and at an angle which will illuminate the board evenly and conceal the source from the observer. The plan of attempting to illuminate boards by placing arc lamps near them has little to commend it, as an arc lamp is such a common thing that its presence near a billboard would probably not attract attention; whereas a lighted billboard with the sources of light concealed so as to make the lettering stand out by night without any apparent cause is of itself something to attract attention. A most effective display advertisement recently observed was that of a rug store, the interior of which was all dark save one handsome rug in the middle which was strongly illuminated from concealed sources of light so that it stood out by itself in a striking manner. The same principle applies in billboard lighting. The darker the surroundings, the better. The point is to get a good illumination on the board itself without showing where the light comes from.

The Cost of Business Getting.

The proper amount of money to spend on a new business campaign has been a subject on which many central station men have done some hard thinking, but upon which few who have made any public utterances or read convention papers have volunteered any information. Mr. Wiltse, in the Co-operative Association paper, printed in this issue in abstract, is to be commended for the departure he has made from this general rule by publishing an estimate giving his idea of the cost of a yearly campaign such as he outlines for a city of 50,000 inhabitants. Probably the aversion all have to printing figures is due to the proneness of the average reader to misapply them and criticise the author. For every one who criticises, however, there are many who profit by having something tangible in the shape of figures laid before them. The figure of $6,296 given by Mr. Wiltse for a town of 50,000 is not at all excessive, considering that it represents only about 12 cents per capita where the gross earnings may be $2 per capita and should be $6 or $8. It is, however, considerably more than most of even the progressive stations in towns of 50,000 are spending. The whole problem of how much to spend a year on getting business is very complicated. Under some circumstances a company could afford to spend a good deal to keep its investment from lying idle, if it were not loaded to its capacity. A plant fully loaded at the peak, while not in a position to push for peak business, is always in a position to profit by non-peak business so that there is always plenty to be done.

The Fan and the Furnace.

An article by Mr. F. N. Jewett elsewhere in this issue contains a suggestion as to the use of the fan motor in winter which is well worth following up by central station companies both large and small. The suggestion is, in brief, the introduction of an ordinary 16-in. fan motor in the cold air supply pipe of the ordinary house heating hot air furnace for the purpose of forcing the circulation of air through the furnace pipes. Two important

results are obtained. One is the rapid heating of the house in the morning after the temperature has fallen during the night, and the other is the forcing of hot air into the rooms on the windward side of the house which are with difficulty heated when the natural circulation is depended upon. Mr. Jewett enumerated all of the tribulations that those of us living in houses warmed with hot air furnaces have experienced. In the early morning there is a great forcing of fires and perhaps the furnace shell is red-hot, but the house does not heat rapidly for the simple reason that the natural circulation of air is not rapid enough. Then again, all furnace users know of the windy days when it is impossible to keep certain rooms warm because the wind pressure keeps the hot air from coming up some of the registers and may even cause cold air to go down them.

Leaving out of account flats and apartment buildings, there are probably more electrically-lighted houses heated by hot-air furnaces than by any other method in this country. The cost of a fan motor installation like that described by Mr. Jewett, ready to operate, is not over $20 or $25, and there are few who live in furnace-heated houses that would not be willing to pay this to overcome the inherent objections which have heretofore been inseparable from this method of heating. Further than this, it is easily conceivable that many residence owners which do not have central station service would be glad to take service for the sake of the fan motor if it could give them a satisfactorily heated house and save an expense of three or four hundred dollars for a hot water or steam heating system, which might otherwise be necessary. It is not at all unlikely that with a fan installation of this kind hot-air furnaces can be made applicable to much larger buildings than at present. The gross income to the electric light company from such an installation during the winter months, while it would probably not be over 25 to 50 cents per customer, is nevertheless worth considering when the number of possible customers is taken into account and when it is remembered that it is a means of popularizing and more firmly establishing central station service as a necessity in the home. The use of the fan motor for circulating air through steam radiators, for drawing air up hot-air registers and for keeping the frost off show windows in winter, has been well known for some time, but its use as a permanent part of a hot-air furnace as suggested by Mr. Jewett promises to be much more important in winter than any other of the other uses enumerated, as it is not a makeshift, but thoroughly good engineering and will bring in a steady winter revenue.

THE COST OF ELECTRIC KITCHENS.

Comparatively few central stations have as yet done much in the way of introducing complete electric cooking outfits in residences. Many central station managers are trying it in their own homes and more should be doing so. The cost of operation for average families of different sizes is not a matter of great uncertainty in view of the data which have been already published on this subject. Most of the data obtained from various sources on this subject show that the figures given by Mr. James I. Ayer at the last National Electric Light convention and reprinted in these columns, are entirely reasonable. According to these figures the number of watts per meal per person may safely be taken at 300, or 900 watts per day per person. Allowing one kw-hour per person per day the cost per month is easily arrived at when the rate per kw-hour is known. For a family of four at a five-cent rate, this would work out at $6 per month. While this is more than the cost of gas in most cases, it is less than that of hard coal. Even if it is more costly it is worth the excess in cleanliness and convenience for every family which can possibly afford it. The greatest obstacle to the introduction of electric cooking, however, is usually considered to be the first cost of the necessary special circuit and cooking appliances. We doubt whether many managers stop to consider that central station companies in the past successfully have accomplished a feat which is fully as difficult as the introduction of electric cooking appliances, namely, the wiring of residences for electric light. Experience has demonstrated that there are plenty of people who will pay $100 to have their residences equipped with electric light. They do not pay this because it is cheaper than kerosene lamps in first cost, but because electricity is clean and convenient, and pays in the long run. Now is it not entirely reasonable to suppose that in the immediate future plenty of people can be found who will pay $100 or $150 for a complete electric cooking outfit and circuit? Electric cooking is just as far ahead of other methods as electric light is ahead of other illuminants, and perhaps farther if all the facts be known. The only trouble is that these facts are not as generally known as those relating to the electric light. The important thing is for central station men to take this matter up seriously, investigate it by use in their own houses, spread information as to the convenience of electric cooking, and last but not least make rates which will bring it within reach of their customers.

When we get to the matter of rates for electric cooking, the important question comes up as to whether it is peak or non-peak load. As to the cooking for morning and midday meals, there is no question that it is non-peak load. The important point to determine is whether it comes on during the November and December 6 p.m. peak. It is evident when we consider the habits of people in large and small cities that the electric cooking peak is much more likely to coincide with the station peak in the former than in the latter, because in the small cities the old American custom of cooking at midday is still in force. In large cities this cooking may be done between 5.30 and 6, but in the class of residences where electric cooking will prove most popular it is most likely to come between 6 and 7 after the down-town lighting, which causes the maximum station peak, has been shut off. With electric cooking as with electric flatirons, no progress is likely to be made either among the very rich or the very poor. It is in families where the mistress of the house does part or all of the cooking that it will prove most popular. The few homes where the man of the house can get home to an early dinner can be left out of account. There will be usually an interval of 45 minutes to an hour in the large cities between the time a man of business turns off the lamps in his office or store and the time he sits down to his evening dinner. Now it is the overlapping of commercial lighting, power and residence lighting that causes the maximum peak loads in our large cities between 5 and 6 p.m. It will be thoroughly reasonable to assume that the men who eat electrically-cooked dinners will leave their places of business long enough in advance of the general shutting off of commercial power and lighting to allow of any cooking peak to come on immediately after and compensate for the load going off. At least this will be the case for many years until electric cooking has reached such a volume that load factors are materially improved and a general reduction of rates for other than cooking purposes will eliminate any difficulties from making a special rate for cooking.

$2,600 in Prizes for an Electrical Solicitor's Handbook.

Earlier in the year, as will be recalled, the Co-operative Electrical Development Association offered $1,000 in prizes for papers on the subject of the organization and conducting of new business departments suitable for central stations in cities of 50,000 population and under. These prizes were awarded by the president of the National Electric Light Association at the Atlantic City meeting on the judgment of a special committee, since which time they have been given very wide publicity through the co-operation of the electrical technical press, as well as issues by the association in pamphlet form.

A few weeks since the subject of offering prizes for an electrical solicitors' handbook was discussed with the Co-operating Committee of the National Electric Light Association, and it was decided to offer $2,600 in prizes for such a production. The prize money is divided as follows:

$1,000 for the light section, of which $500 will be awarded as the first prize, $300 as the second and $200 as the third.

$1,000 for the power section, of which $500 will be awarded as the first prize, $300 as the second, and $200 as the third.

$600 for the heat section, of which $300 will be awarded as the first prize, $200 as the second and $100 as the third.

In general it is desired to secure a handbook which will be both instructive and stimulating to representatives of central stations, contractors or others who are soliciting the public for the sale of electrical service for light, heat and power.

A little pamphlet is in the course of preparation containing general suggestions for the benefit of those who will compete for the prizes, and this will be very gladly sent upon request.

A committee appointed by the president of the National Electric Light Association will judge the handbooks, or sections of the handbooks, submitted, and their decision which will be made just before the next meeting of the National Electric Light Association will be announced at that convention, and the nine New York drafts for the several amounts distributed to the winners.

The winning contributions, or combination of winning contributions, will be made of the greatest possible benefit to the electrical business along such lines as may be later determined by the joint committee.

This affords an excellent opportunity to make a valuable contribution to the commercial progress of the art, to achieve a reputation for business progressiveness, and, withal, to be well paid for the time, thought and energy required. Prospective competitors should apply for the pamphlet giving fuller details of this interesting contest, to the Co-operative Electrical Development Association, Cleveland, Ohio.

Electric Steel.

The New York *Sun* of November 21 devotes four columns of its editorial pages to a severe criticism of recent sensational methods employed in the exploitation of a scheme dealing with the production of steel direct from ore. The article quotes largely a prospectus issued by the Black Sand & Gold Recovery Company with head offices in Chicago, which prospectus bears on its front cover the following statement:

"This pamphlet tells how the Government of the United States has recently made steel in commercial quantities for $15 per ton less than the Steel Trust can make pig iron." The Black Sand & Gold Recovery Company proposes to work on the black sand of the Pacific Coast, this sand containing considerable quantities of magnetic oxide of iron, and to produce steel in electric furnaces. The principal basis of its appeal for subscription to its stock is certain work carried on recently under the direction of Dr. David T. Day, chief of the Mining and Mineral Resources Department of the Geological Survey.

The anonymous writer in the *Sun*, who is evidently very intimately acquainted with the latest developments of the metallurgy of iron and steel, first gives a brief and popularly-written review of the general fundamental principles of the metallurgy of iron and steel, and of those points where electric furnace methods might be able to compete with the old metallurgical methods. The writer's conclusions are conservative, but they represent the present status of the art.

Concerning competition of the electric furnace with the blast furnace for pig iron production, he says that such competition is impossible where coke is cheap. Only under exceptional conditions where electric power is cheap and coke dear it may be possible to produce pig iron at a lower price than the blast furnace product can be marketed.

Concerning the manufacture of steel in the electric furnace, reference is made to two types of furnace which have proven commercially successful. One is that of Héroult and Keller, in which two electrodes dip into the slag above the steel bath, but not into the latter itself. The other type is the induction furnace of Colby and Kjellin. It is pointed out that for the manufacture of high-grade tool steels (such as are now made by the crucible process) the electric furnace has certain advantages, and that it is possible that with the development of the art, the electric furnace may in time also encroach upon the field of the open-hearth furnace.

In connection with the black sand deposits of the Pacific Coast, Congress made an appropriation of $25,000, afterward increased by a second appropriation to $50,000, for their investigation. This investigation was carried out under the supervision of Dr. David T. Day, chief of the Division of Mining and Mineral Resources, United States Geological Survey. The complete official report by the Government on this work has not been issued, but certain semi-official articles have appeared giving some information as to the Government work. These articles have chiefly appeared in daily newspapers and their general tone may be described as sensational.

Reference is made to an article in the issue of the Chicago *Inter-Ocean* of Sunday, January 21, 1906, from which the following quotations are made:

"Dr. Day, after demonstrating that many of the sands tested contained as high as 600 pounds of iron to the ton, erected a ten-ton electric furnace, and in one short hour, by adding lime and broken coal to the iron which had been separated from the black sands, smelted the iron into high-grade steel." One of the conclusions stated to be "demonstrated beyond question" by Dr. Day and his associates is "that the steel so produced, smelted with cheap electricity generated from water power, need not exceed $12 per ton, while the present cost of pig iron on the Pacific Coast is over $27 per ton—a saving of $15 per ton over present prices of pig iron alone." A letter from Dr. Day to the business manager of the *Inter-Ocean* is also quoted to the effect that the process requires "little in order to make it perfect."

The correctness of these statements is most severely criticized by the writer in the *Sun*, who quotes an article from the *Technology Quarterly* by Prof. R. H. Richards, who was associated with Dr. Day in the black sand investigation. There Dr. Richards states that the furnace "is still in the experimental stage. As to the means of controlling the contents of the steel in silicon, carbon, manganese, sulphur and phosphorus." The writer in the *Sun* points out that it is obviously absurd to talk of manufacturing steel when the contents in carbon, silicon, etc., cannot be controlled.

Many investigators have made extended experiments to make steel directly from the ore in one operation, but all have failed so far in solving this problem, and "we may feel confident that this was not done in the crude experiments made by the Government at Portland," especially if the type of furnace used in these experiments is considered, which is in no way suitable for making steel. "Under these circumstances it would be a waste of time to discuss the possibility of turning out steel from an electric smelter at $12 a ton."

In taking up again the pamphlet of the Black Sand Gold Recovery Company the writer in the *Sun* says: "But it is not only the fatuous experiments of the Government's employes that are used to excite the plain people to buy stock in the company, for various forms of subtle misrepresentation are also employed. For example, the prospective investor is inclined to infer, after reading the literature furnished him by the company, that one C. E. Wilson, who is described as 'the foremost furnace electrical expert of this country' is T. L. Wilson, whose name is intimately associated with the development of the calcium carbide

industry in America. Even if the blame for this misapprehension can be shifted from the company to its dupes, no excuse can be found for another ambiguous suggestion. One of the illustrations in the company's pamphlet shows 'pig iron melted in the electric furnace,' and the reader is led to infer that this pig iron was manufactured by Dr. Day and his associates or by the Black Sand & Gold Recovery Company. The illustration actually had its origin in a photograph of pig iron taken during the experiments made under the auspices of the Canadian Government in Sault Ste. Marie during January and February and March of this year. Perhaps reference to those experiments is avoided because from the results it has been estimated that under favorable conditions crude pig iron might be produced at about the cost advertised by the Black Sand & Gold Recovery Company for finished steel. But then such facts as this would be of no assistance in the sale of stock to gullible 'plain people.'"

In contradistinction to this scheme, attention is called to what is called "a well-conceived enterprise" in California, namely that of Mr. Noble, of the Northern California Power Company, who is putting up an experimental electric furnace plant to make pig iron from the ore of the Shasta Iron Company.

The writer in the *Sun* concludes as follows:

"It is lamentable that just when the electric furnace is emerging from the laboratory into a useful metallurgical apparatus it should have to bear the odium of such irresponsible wildcat exploitations as that of the Black Sand & Gold Recovery Company. But it is still more deplorable that such schemes should find a basis in the inexpert activity of governmental bureaus."

Eleventh Annual Report on Detroit Municipal Lighting.

The Public Lighting Commission of Detroit, Mich., has just issued its eleventh annual report, for the year ending June 30, 1906. It is a handsome, well-printed document, whose pages bristle with data and views of the plant, and whose value to the statistician is enhanced by the fine group half-tone, with lightning ray background, of the comely gentlemen constituting the board. There are now six active members, as usual, but already 18 have left the commission, whose names and terms are duly set forth. The portraits of the men operating the system are not given, but had the pamphlet been printed by the Boston municipal printing office this could doubtless also have been afforded. It is not quite clear whether the commission prints the report itself or not, or whether it makes any pro rata contribution at all to the expense of publishing the city "Red Book," in which details of its current appropriations, etc., are given. Peculiar and special interest is given to this report by the offer of President John I. Beggs, of the Milwaukee Railway & Lighting Company, to furnish lights to the Wisconsin city at the exact proved cost of the Detroit municipal lamps—all actual, legitimate charges in. It is to be feared, however, that the accountants determining that figure will have to probe below the optimistic, superficial figures of this rosy document which certainly does not quite answer the question: "What is truth?"

The commission is now operating a plant of 6,500 hp capacity with 3,241 arc lamps in use, disposed on poles and towers, operated nominally 3,779 hours a year. This lighting includes 65 of the obsolete high lattice towers that should long since have been scrapped. There are also connected 564 lamps of 8 cp, 16,174 of 16 cp, 537 of 32 cp, 252 Nernst glowers, 52 power motors of 239 hp, and 53 desk fans. The output for the plant is returned at 5,128,839 kw-hours of arc lighting and 1,244,420 kw-hours of incandescent lighting. The cost per kw-hour is estimated at $.01992 as compared with $.02062 in the previous year. The cost of an arc lamp is given as follows:

Operating disbursements	$33.18
Depreciation on discarded machinery, etc.	2.36
Depreciation at 3 per cent on investment	7.29
Interest at 4 per cent on investment	9.12
Loss of taxes on investment	2.44
Total	$54.39
Gross cost, 1905	59.34
Decrease	$4.95

For the present year the estimated total expenditure is $221,739, offset by receipts from other sources, $8,500; balance from 1905 of $19,681.60, leaving a net appropriation of $193,557.04.

The report of the commission is subject to the same old criticisms as previous reports in the matter of absence of inventory of the property, no inventory having been taken for ten years or more; the arbitrary and inadequate depreciation charge of 3 per cent; the arbitrary method of dividing the cost between arc and incandescent services; failure to show in any way the real amount of incandescent lighting actually performed, the charge for incandescent lighting being on the basis of switchboard output and not on the basis of energy delivered at consuming points. The report is entitled to honorable mention in that the text contains no argument as to the value of municipal lighting. It also calls for commendation in that it shows a continuation of the annual charge-off for lines and machinery discarded. There is no new occasion to criticise the commission. It is attending honestly to its business as usual; and some day, whether by change of membership or by an accession of courage of the old members, it may have nerve enough to put its accounts on an entirely business-like basis.

The street service for the twelve months is just about as it has been. The old Brush lamps in use are neglected and burn very badly. The lack of uniform adjustment of the arcs is notable on all circuits whether they are equipped with old lamps or new. The commission could spend some money to the improvement of the service in adjusting lamps and in patroling lines—possibly $2.00 per lamp per annum.

The commission, as usual, gives an intelligible account of cash expenditures. The distribution of those cash expenditures between the arc and incandescent systems is crude and tends to make the cost of street lighting per arc per annum lower than it really is, while the cost of incandescent lighting is made to appear low by giving cost at switchboard only; which is probably less than half the cost per kilowatt-hour delivered at the public buildings. The depreciation charge of 3 per cent is inadequate even though of late years the commission has made a further charge for machinery and lines discarded. The continued absence of a valued inventory of the property leaves the calculated annual cost of lighting open to serious question. The management of the plant is, we understand, honest, and there is no apparent grafting. Politics (at least during the period stated) has not interfered with the efficiency of operation. The quality of street lighting service is not quite up to the average. It is notably inferior to the New York or Boston contract service and could not possibly be compared with either.

It is to be remembered that the Detroit Public Lighting Commissioners are unpaid, and that beyond doubt the very great majority of the gentlemen who have served as commissioners have done the best that they knew for the city purely from public spirit. It is also to be remembered that the commission is bipartisan and that consequently any serious attempt to introduce politics into the operation of the plant might be expected to cause warm dissensions on the board. To these conditions must be attributed the result that the annual reports of the commission come so near to being true and complete statements of the facts. Yet they fall far short of revealing the true situation of affairs.

Heavy Electric Traction.

At a meeting last week of the American Society of Civil Engineers, Mr. Joseph Mayer presented a paper which discussed the relative advantages of direct-current and single-phase operation for the electrification of the Lake Shore & Michigan Southern Railroad, from Buffalo and Cleveland, and described a new type of overhead conductor, on which he has applied for patents. This consists of a soft-steel rod circular or figure eight in section, and to be substituted for the copper conductor in catenary line construction. The section of the conductor would vary with the speed of the train and oscillatory weight of the collector. For a speed of 80 miles per hour and a collector weighing 25 lb. above the supporting springs, the rod would be 1¼ in. in diameter.

The suspenders can be spaced 12 ft. apart without risk of compression when the sliding bow passes. Calculation shows that the center deflection of such a rod is only 1/9 in. The up-and-down oscillation of the collector increases the pressure on

the contact conductor 22 lb. when it passes the suspender, and it decreases the pressure 11 lb. when it is at the center of the span. The pressure when at rest may be made 20 lb. The maximum pressure will then be 42 lb., and the minimum 9 lb. The largest bending strain per square inch in the rod will be so small that it will be safe even with welds of mediocre quality. The collector roller might be considerably heavier than 25 lb. without risk of breaking the contact rod. With a 1¼-in. contact rod, therefore, it is easy to design a rolling collector which has abundant strength and is very durable, thus greatly diminishing the cost of maintenance. This rod is supplied at intervals with expansion joints, which are spanned by flexible copper bonds.

In the discussion which followed the paper, Mr. Frank J. Sprague referred to the desirability of using higher potentials than those at present employed in direct-current work, but advocated a third rail and direct current in preference to alternating current with overhead conductor. In his comparison of the two systems he said:

"The third rail offers certain hindrance to the ordinary maintenance of track, but overhead construction is inelastic, and the laying of additional tracks or changes in grade and alignment require radical and expensive alterations in permanent overhead structures. Derailments will crush one form of conductor to the ground, but may equally well knock down the supporting structures of the other and put all tracks out of service. In wrecking the third rail offers some obstruction to the throwing of the equipment to one side, but conductors overhead may interfere with the operation of crane booms. With two or more tracks snow cannot well be piled up between them when the space is occupied by third rails, but on the other hand overhead conductors are a source of danger to trainmen, and subject to the troubles of sleet formation."

He did not believe that snow and sleet would cause complications with the third rail at frogs and switches, while he did believe that an overhead high-potential conductor would prove objectionable at overhead street and highway bridges, in tunnels and at low bridges, and as possibly intercepting the train operator's view of semaphore signals. He also compared direct-current and single-phase motors and locomotives for heavy traction conditions, and stated that the weight and cost of the motor equipment is much higher for single-phase than for direct current, that the cost of permanent working conductors per mile of track is fully as high, and that the cost of a central station would be somewhat greater because of the reduced capacity for weight of material for single-phase generating apparatus. He also thought when extended systems are considered the increased cost of the sub-stations for direct current with their transformers and rotaries would be more than offset by the increased first cost and the cost of operation of the motor equipment on the alternating-current system when each is installed with equal regard to permanency.

Causes of Ohio Fires in 1905.

The report of Hy. D. Davis, state fire marshal of Ohio, for the year 1905 gives summaries of causes of fires in that state which are of interest to central station men as showing the small percentage caused by electric wiring and the large percentage from causes which the general use of electricity for power, lighting and cooking would eliminate. They would also seem to indicate that if inspection of the more common methods of heating and lighting were as rigid as the inspection of electrical wiring and apparatus, there would be an enormous reduction in fire losses. Of course, no scientific comparisons are possible because there is no method of determining just what portion of the buildings in the state are wired for electric power or light. However, out of a total of 4,851 fires in all kinds of

Defective flue	591
Electric wires	71
Gas jet near wood	30
Overheated stove	155

buildings the above are some of the principal causes, which could be reduced by more careful inspection of insured property to see that dangerous appliances are kept in proper condition.

The following are from causes which are inherent in the dangers of the system of heating or lighting used and which could probably be only slightly reduced by any practicable system of rules or inspections:

Gas explosion	48
Gas stove near wood	22
Gasoline explosion	150
Gasoline stove and lamp explosion	157
Kerosene or gasoline lamp explosions	43
Kerosene or gasoline lamps dropped or upset	56
Carlessness with matches	138
Children with matches	138
Mice with matches	63

Coming now to dwellings the report shows a total of 2,554 fires. Among those preventable by more rigid inspection and rules of installation we find:

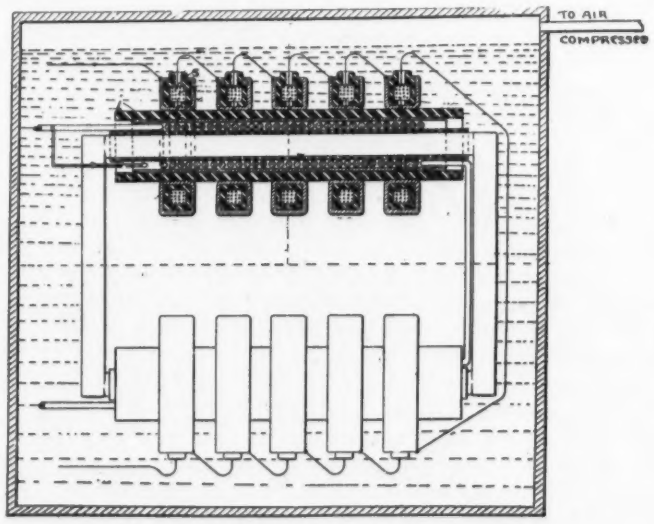
Gas jet near curtain	22
Chimney soot burning	31
Defective chimney	115
Defective flue	368
Defective furnace	10
Defective gas stove	10
Defective grate	20
Defective hot air pipe	3
Defective rubber hose connection	14
Defective stove	18
Electric wires	10
Gas jet	13
Overheated flue	4
Overheated furnace	23
Overheated furnace pipe	4

Among those from causes inherent in the system used are:

Gasoline stove explosions	129
Gasoline explosions	100
Gasoline lamp explosions	3
Kerosene lamp explosions	59
Gas explosion	25
Carelessness with matches	222
Mice and rates with matches	36
Overheated stove	92

Compressed Gas as an Insulator.

On Nov. 6 Prof. Harris J. Ryan obtained a patent for means for obtaining extremely high dielectric strength. The conductors are provided with "minor" insulation, of the ordinary kind which immediately surrounds them. The electrical apparatus is mounted in a compartment structurally capable of withstanding an ample pneumatic pressure. Air (or other suitable gas) is then introduced into the compartment under a pneumatic pressure sufficient to cause the density of such air (or gas) to rise to and be main-



COMPRESSED GAS INSULATED TRANSFORMER.

tained at a point by virtue of which all air (or gas) confined within the compartment has attained a dielectric strength ample to withstand without rupture the dielectric flux occasioned by the electric pressure to which the electric circuit thus insulated is subjected or which is applied thereto or generated therein. For example, it is estimated that at a pressure of forty atmospheres the dielectric strength of the air should be as great as linseed oil bond paper, at eighteen atmospheres it should be as good as that of micanite cloth, and at eight atmospheres it should equal that of melted paraffin or boiled linseed oil.

November Meeting of A. I. E. E.

At the opening of the regular monthly meeting of the American Institute of Electrical Engineers, held November 23, Secretary Ralph W. Pope announced that on the evening before upon the invitation of the trustees of the United Engineering Society, the boards of directors of the three founder societies inspected the new building. The office floors are practically complete and ready for occupancy; the auditorium and grand entrance hall on the first floor are yet in the hands of the contractors. All were impressed with the stately character of the building, and all felt satisfaction with the way the architects have carried out the great work. There was an informal dinner at half-past six, and although the meeting was of an informal character, resolutions were passed authorizing the trustees of the United Engineering Society to proceed with arrangements for the formal dedication of the building in April next. The societies will, however, occupy their suites in the building in the course of a month or two.

At this informal gathering Chairman Thomas Commerford Martin, of the Building Fund Committee, announced that Mr. George Westinghouse, for himself and as representing the various Westinghouse Companies, had contributed to the land, building and endowment fund the sum of $50,000, to be equally divided between the three founder societies toward the payment for the land. This was followed by the announcement that the Allis-Chalmers Company had contributed the sum of $3,500, to be similarly divided between the three societies. This brings the amount pledged toward the payment of the A. I. E. E. proportion of the land to $155,000, out of $180,000, which is the sum total. Chairman Martin assured the gentlemen present that he felt that when the building was formally dedicated, so far as the American Institute of Electrical Engineers was concerned, it would assume its responsibility, one-third of the land, free from debt.

Mr. Pope said that from his knowledge of the situation he feels quite assured that this will be the case, and that the American Institute of Electrical Engineers, which twenty years ago was following the trail of the other engineering societies, will assume its responsibilities free from debt and with an income that will assure the handling its part of the building for all time to come, with the generous support of the members of the Institute. The building is admirably calculated to accommodate meetings of various societies, from an audience of 1,000 down to 150, and the accommodations are such that all will feel well satisfied personally with the situation, when they come to meet in the building and inspect the offices and the general quarters, the library and all the accessories.

The first paper of the evening was by Dr. C. P. Steinmetz, the title being "Transformation of Power into Light." This had previously been delivered in the form of a lecture several months ago before the Philadelphia branch of the Institute. An abstract is printed elsewhere in this issue.

The second paper of the evening was presented by Dr. Clayton H. Sharp, the subject being "New Types of Incandescent Lamps." The paper considers the improvements made in the incandescent lamp within the past two years. The osmium lamp is dismissed with the statement that despite its high efficiency and long life it seems precluded from exercising any revolutionary influence on lighting practice on account of its low voltage, and most of all by the limitations of the visible supply of the material of which the filament is composed. Since the graphitized or so-called "metallized" carbon filament has become a regular commercial product, the properties of which are moderately well known, the author devoted little attention to this type, deeming it best to take up more in detail the peculiarities or the properties of the tantalum and the tungsten lamps.

Tungsten is quite plentiful and is commercially obtainable in the form of a fine powder. The metal, according to Dr. Sharp, does not seem to be ductile, so that it cannot be drawn directly into fine wire as is the case with tantalum. Because tungsten unites readily with oxygen and with carbon at high temperatures the problem of producing tungsten filaments has been difficult. Dr. Sharp describes the processes of Dr. Kurzel, Dr. Just and Hanaman and that of Dr. Auer von Welsbach, the latter process being used by German and Austrian companies engaged in the manufacture of tungsten lamps. With reference to the physical characteristics, tungsten lamp filaments manifest all the ordinary properties of wires of pure metals. They have a high conductivity and a large positive temperature coefficient. The former characteristic requires that the filaments be very fine and quite long if they are to be used in producing lamps giving a reasonably low candle-power on 110-volt circuits. The filaments are moreover quite soft at the temperature of full incandescence, so that it is not feasible to mount them in lamps in any other form than in loops.

The first tungsten lamps produced were designed for low voltages and in consideration of the high conductivity of the material this is a simpler problem than the production of lamps for higher voltages, since in the former case a shorter length of the filament may be employed. It is also easier to produce a lamp of high candle-power than of low candle-power, since a stouter filament may be employed in the high candle-power lamp.

As far as Dr. Sharp knew, no 110-volt lamps have been produced as yet for lower candle-powers than 25 and no lamps have been produced for higher voltages than 220. The fineness of the 110-volt, 25-cp filament is such that it would seem to be difficult to produce such a lamp as a regular commercial article. The 220-volt lamps are probably only experimental as yet. The properties of the tungsten filaments are such that it would seem to lend itself very readily to the production of most excellent lamps for street lighting by the series incandescent system. Lamps for 110 volts are likely to have, when commercially produced, a watt consumption of 50 watts or more. If tungsten lamps are to be made for small candle-powers, such as are commonly employed in domestic lighting, they would probably need to be made for 50 volts or under, and consequently either burned in series or connected to low-voltage mains.

One of the chief disadvantages of the tungsten lamp lies in the extreme fragility of its filament. Blows or shocks given to the lamp are quite likely to cause a rupture of the filament. A ruptured filament may, however, mend itself by the parts welding together once more, but where the filament has become welded it is quite likely to break again.

The feature which differentiates the electrical behavior of the newer lamps from the ordinary carbon lamp is their positive temperature coefficient. The effect of this is to give the lamps considerable inherent regulation. That is, the change of current through the lamp is no longer proportional to the change in voltage, but is smaller proportionally than this change. Consequently in candle-power and watts per candle, these lamps undergo smaller changes with the change in the line voltage than is the case with the carbon filament lamp. This is shown in the accompanying table, which gives the change in candle-power and the watts per candle of carbon, metallized, tantalum and tungsten lamps with 5 per cent rise in the voltage.

CHANGE WITH 5 PER CENT INCREASE IN VOLTAGE ABOVE NORMAL.

	Candle-power.	Watts per candle.
Carbon	+30%	—15%
Graphitized	+27%	—13%
Tantalum	+22%	—11%
Tungsten	+20%	—10%

The quality of the lamps here pointed out is a very valuable one, since it must have two important results:

1. The light of the lamps is less affected by bad regulation of the circuit. This means that with a given degree of regulation of the voltage on the circuit the service must be more satisfactory to the user, and has a direct bearing on the amount of copper required in feeders.

2. The life of these lamps is probably less affected by the momentary or even continued application of excessive voltages.

Another interesting consequence of the positive temperature coefficient is that at the instant of closing the circuit the current through a metallic filament is much greater than it is a fraction of a second later when the current has had time to heat the filament to its normal temperature. In other words, there is an initial inrush of current similar to that experienced in an arc lamp or in a motor, but enduring for a much smaller period of time. The behavior of the ordinary carbon filament is the reverse of this.

With reference to the distribution of luminous intensity the author stated that it was absolutely necessary, if any adequate idea of the performance of the tantalum lamp was to be obtained, to make measurements of the mean spherical rather than the mean horizontal candle-power. The spherical reduction factors for twenty tantalum lamps tested was extremely variable, falling as low as 0.69 and rising as high as 0.76. With the carbon filament the spherical reduction factor is quite definite. Owing to the relatively high cost of the lamps they are likely to be burned until they fail.

The author showed that with alternating current at different frequencies, the filament of the tantalum lamp showed increased wear and tear, and however obscure the reason the conclusion was inevitable that the tantalum lamp at the present time is essentially a direct-current lamp. No such effect is observable with the tungsten filament and tests show quite definitely that the life of the tungsten lamp on direct current and on alternating current is the same.

The life history of the tantalum lamps is characterized by a large initial increase in candle-power and a corresponding decrease in watts per candle, the extreme values being reached at the end of about 25 hours. From this point on the candle-power decreases at a moderately rapid rate and the watts per candle increase. The rate of decline of the mean horizontal candle-power is more rapid than that of the mean spherical candle-power.

The author gives the results of a number of foreign tests on tungsten lamps, one of which reached the extraordinary life of 3,537 hours with a decrease in candle-power of about 10 per cent. The color of the light from the tantalum lamp is whiter than that of the carbon lamp, and the color of the tungsten lamp is still whiter than that of the tantalum lamp. The light of the tungsten lamp resembles quite closely that of the acetylene flame. The increased whiteness of the light constitutes the real superiority of the tungsten lamp, and may theoretically be due either to higher temperature of the filament or to selective radiation by the filament.

The author states that it has been established as a result of practice that in general it is not possible to operate incandescent lamps on 25-cycle current with satisfactory results. In order to ascertain whether tungsten lamps presented any advantages over the carbon lamp in this respect a few preliminary tests were made, and if the results of these hastily made tests can be confirmed by later and more careful experiments, the tungsten lamp will be found to be less adapted to use on alternating-current circuits of low frequency than the standard lamp of to-day. The author concludes from the data obtained that it seems certain that the electric lighting industry is face to face with a change of almost revolutionary character. The standard of incandescent lighting efficiency will be brought by the tungsten lamp to a point about three times as high as it is at present. The efficiencies of all other incandescent lamps and of enclosed arc lamps are exceeded by that of the tungsten lamp. In other words, with the possible exception of some forms of vacuum-tube lighting and of the magnetite and flaming arc lamps, the tungsten lamp is the most efficient electric illuminant. Combined with its virtue of high efficiency it has the other advantages of incandescent lamps in being perfectly simple in its character and construction and in being capable of sub-division into small units.

An interesting discussion followed the reading of the two papers. This was opened by Prof. H. C. Parker, of Columbia University, who was followed by Mr. J. W. Howell, of the General Electric Company, who called attention to the remarkable performance of the tungsten lamp and stated that the smallest tungsten lamp that his company will manufacture for 110-volt circuits will be a 40-cp lamp. For lower candle powers a lower voltage would probably be necessary or lamps may be burned in series. Mr. J. W. Lieb, Jr., of the New York Edison Company, spoke from a commercial viewpoint, and stated that the question of mere efficiency does not represent an advance if it is obtained at too great a cost. If high efficiency were obtained at the cost of life, even though the cost were low, a lamp would be impracticable because continued renewing and burning out would be very inconvenient. He had hoped that a lamp for use on 25-cycle alternating current and of high efficiency would be forthcoming, but was disappointed.

Mr. W. J. Hammer spoke of the earlier developments of the incandescent lamp and called attention to the fact that Mr. Heany had succeeded in rendering the metal tungsten ductile. Mr. Heany, who was present, begged to be excused from going into any details regarding his work in this direction. Dr. Steinmetz, in closing, and replying to a number of questions, stated that his view of a vacuum was radically changed after conducting a number of experiments with the mercury arc. He measured a vacuum now by the time it took to flash up a mercury arc. What he heretofore considered to be a very good vacuum proved to be a very poor vacuum. He said that ductility was not a valuable property of tungsten in connection with incandescent lamps. If ductile tungsten were used he felt that the lamp would be inoperative on alternating current just as the tantalum lamp is now. He spoke of the disadvantages of the tungsten lamp from an illuminating viewpoint, stating that it was not as good as the ordinary carbon lamp at 110 volts because it could not be made in as small units at this potential as the latter.

CURRENT NEWS AND NOTES.

LECTURE ON TELEPHONY.—The Electrical Engineering Society of Columbia University announces its next meeting to be held on December 5 in Room 301, Engineering Building of the University, at 8.15 p. m. Mr. C. J. H. Woodbury, of the American Telephone and Telegraph Company, will present an illustrated paper on "The Telephone System." All interested are cordially invited.

ELECTRIC TRACTION ON THE ERIE.—It is stated that the electrification of 30 miles of the Rochester division of the Erie Railroad will be completed by January 1. The success of this experimental installation, it is stated, has been so pronounced that the company has decided to electrify the remaining 70 miles of the division to Corning and branches to Dansville. The electric power will come from Niagara Falls and will have to be transmitted a distance of about 225 miles.

SCHENECTADY BRANCH, A. I. E. E.—At the regular weekly meeting of the Schenectady Branch American Institute of Electrical Engineers, held Friday evening, November 23, Mr. F. O. Blackwell gave an interesting lecture, illustrated by lantern slides, on recent hydro-electric developments. Mr. Blackwell, now with the consulting engineering firm of Viele, Cooper & Blackwell, New York, but formerly chief of the General Electric Company's power and mining engineering department, was greeted by the largest audience of the season, the attendance being about 600, or nearly three-quarters of the total membership of the branch. Mr. Blackwell chose as typical illustrations of his subject the Necaxa plant of the Mexican Light & Power Company, which supplies the City of Mexico, and the Niagara plant of the Electrical Development Company, of Ontario. The marked differences in the hydraulic machinery and the similarity in the electric generating, controlling and transmission apparatus made the comparison of these two examples of recent installations doubly interesting. The paper was followed by a discussion in which a number of the members took part and a quantity of valuable information regarding details not mentioned in the formal address was brought out. Last week the plan of sending members of the Schenectady Branch to the New York meetings of the Institute at the expense of the branch was started. Two, Messrs. Hill and Macmillan, attended as a reward for conspicuous merit in a recent debate on municipal ownership. Opportunity is given to all the members of the branch to compete for these trips by taking active part in the discussions of papers and topical debates on live subjects held at intervals throughout the year. The success of this incentive to oratorical effort is demonstrated by the great difficulty experienced by the committee in differentiating from the many excellent speakers being developed the most worthy recipients of the prize. On Saturday evening, December 1, Mr. W. S. Andrews, of the General Electrical Company, will speak on the subject, "Pioneer Work in Incandescent Lighting."

LIGHTING RATE LAWS.—With a view to assisting the public to an understanding of the policy of the State toward lighting companies and municipal ownership, the Massachusetts Gas and Electric Light Commissioners are preparing for publication a small pamphlet giving in systematic and indexed form all the laws now in force relating to all phases of gas and electric lighting, including the "sliding scale" act for the Boston Consolidated Gas Company. The book will be published within a week or two.

ILLUMINATING ENGINEERING SOCIETY.—The Chicago Section will hold a meeting Thursday evening, December 6, taking dinner at Burton White's restaurant, 124 Adams Street, at 6 p. m., and proceeding immediately to discussion thereafter as at the very successful meeting held in November. The section will discuss the questions of show window lighting and chandelier design that had to be left over from last time, and will also discuss the three following papers: "Location of Lamps and Illuminating Efficiency," by Preston S. Millar; "Fixture Design and Location," by Major E. L. Zalinski, and "Residence Lighting," by F. N. Olcott.

TO SAVE NIAGARA FALLS.—Secretary of War Taft's office force is, according to a Washington dispatch, having a busy time caring for hundreds of postal cards and letters begging Mr. Taft to save Niagara Falls. They are a result of the propaganda of the American Civic Association to stop the wholesale use of water for electric power. By an act of Congress the Secretary has the power to limit the importation of power. If a large amount of power is permitted to be imported from Canada, then the plants on the other side will use all the more water and will consequently affect the beauty of the falls. The communications to the Secretary of War come from all parts of the country.

THE STATE COMMISSION.—At Albany, N. Y., on November 24, Justice Fitts, in the Supreme Court, heard arguments on the return of the writs of prohibition secured by the Municipal Gas Company and the Albany Electric Illuminating Company, to restrain the State Commission of Gas and Electricity from investigating complaints against those companies as to the price, pressure and quality of gas and the price of electricity. The companies attack the constitutionality of the law creating the commission, and contend that the Legislature had no right to delegate its authority to the commission for the purposes of investigation. Deputy Attorney-General Graham maintained that the commission had the authority to investigate. He opposed the granting of a permanent writ, and said that the plaintiffs had not sought the proper remedy for relief.

CHICAGO ELECTRICAL SHOW.—Mr. Homer E. Niesz has made arrangements to have the first installation in the West of the Moore vacuum tube light at the Chicago Electrical Show, January 14 to 26, 1907. Mr. Niesz also hoped to get a temporary installation of the Cahill telharmonium. This was found to be a physical impossibility, as there is now only one telharmonium completed, which has begun giving its musical service to clubs, hotels, cafés and residences all over New York. However, it is asserted, a long-distance test of the system will be attempted. An effort will be made to transmit music over the long-distance telephone wires from New York to the Coliseum at Chicago during the exposition. Transmission has already been made between Holyoke, where the plant was constructed, and Holyoke, Mass. Nearly all of the space in the main part of the Coliseum has been taken by exhibitors and there is little doubt but that the annex will also be occupied.

LECTURES AT THE UNIVERSITY OF MINNESOTA.—On Saturday, November 17, Mr. F. A. Sager, of the Arnold Company, Chicago, lectured before the engineering students of the University of Minnesota on "What Is an Engineer-Constructor?" Taking as an example the design and construction of a railroad repair shop, Mr. Sager outlined the steps in analyzing the problem, making preliminary studies of various plans, selecting the best plan, tabulating estimates of cost, making the preliminary report, tabulating and analyzing bids, keeping record of progress and cost of the work, etc. Analogies were shown between the organization of the engineering office and of a football team; electrical, civil, structural, industrial, architectural, sanitary and mechanical engineers corresponding to the line, the purchasing agent as quarter, the constructing and operating engineers as half-backs and the accountant as full-back. There must be full co-ordination and co-operation for every part of the team for effective work. In an engineering office, loyalty is of the greatest importance, common sense and skill coming next. On November 22 Mr. C. H. Harris, engineer with the Minneapolis General Electric Company, lectured to the engineering students on "The Taylors Falls Development." Mr. Harris is the resident engineer in charge of the hydro-electric development at Taylors Falls, which is to furnish 12,000 hp at 50,000 volts to Minneapolis, a distance of 50 miles, the ultimate capacity being 24,000 hp.

A WONDERFUL CLEAN-UP.—Not long ago the Bonanza Basin Gold Dredging Company, operating an Allis-Chalmers gold dredge in the Bonanza Basin, Alaska, reported the finding of a perfect specimen of magnetic iron ore, or lode-stone, in the dredge clean-up. Although, from its unusual size, the specimen referred to was a rather remarkable one to be picked up by the dredge, it seems that a still more remarkable clean-up was made recently from the same outfit, one of the most marvelous ever heard of in mining history. When the long sluice box was opened recently it was found that the bed of the slough which had just been worked had yielded an assortment of stuff, the equal of which has never before been seen in the mining regions of the West. The collection disclosed, among other things, two Russian bronze ikons which had probably been carried into the region by Russian explorers many years before the Klondike was heard of. Besides the ikons were found eight American pennies. There were also recovered about 100 pounds of unexploded cartridges, gallons of bullets, many of which had a coating of amalgam, which necessitated their treatment for the gold adhering; 120 pounds of nails of all sizes, an alarm clock, a saw set, two Masonic gold charms, an opal with its setting from a broken scarf pin, innumerable pieces of watch chains, knives, forks, keys, locks, native bismuth, cassiterites, stanitos, magnetic cubes, magnetized octohedrons, bushels of black sand and a number of nuggets worth over $10 apiece. The last item caused some surprise, as it had been generally understood that the gold in the basin was of a fine quality.

PATENT OFFICE REFORM.—At Rochester, N. Y., on November 24 the International Congress of Inventors received reports from various parts of the country substantiating the statements made by the secretary, Ralph T. Olcott, at a recent meeting, regarding the urgent need of additional examiners in the United States Patent Office and of larger salaries for the force of examiners. One of the principal communications was a report by a special committee of the Patent Law Association of Washington, in which it is stated that more than 20,000 inventors have been forced to wait in some cases seven months for their applications to be passed on. To show that the examining corps is not censurable for this condition, the report states that while the work has increased since 1899 more than 70 per cent the force, including clerks who do not examine applications, has increased only 12 per cent. The report recommends that at least twenty additional divisions be provided, each comprising seven examiners; that better salaries be paid in order to retain the services of experts, and that additional room be provided to accommodate the enlarged force of examiners. These are exactly the recommendations that will be made by the International Congress of Inventors, whose headquarters are in this city. The matter is in the hands of a committee of the organization. The inventors are preparing to present the matter before Congress at its opening. Mr. John Heberling reported that Commissioner Allen was disturbed because the International Congress of Inventors had laid the subject of present conditions in the Patent Office before President Roosevelt, who in turn had directed the attention of the Secretary of the Interior to the matter. Secretary Olcott produced a letter from President Roosevelt stating that the subject had been referred to Secretary Hitchcock.

WIRELESS IN PHILIPPINES.—A cablegram from the Philippines to the U. S. Signal Corps states that wireless telegraphy had been installed between Jolo and Zamboango, 100 miles apart. This is the first wireless system to be installed in the islands.

TUNNEL UNDER SEINE.—It is announced that the French Government has retained Charles M. Jacobs, of this city, who designed the Pennsylvania Railroad tunnels under the North and East Rivers, to prepare plans for a tunnel to be built under the River Seine from Rouen to Havre at the river's mouth. The French tunnel will have two railroad tracks. It will be about a mile in length. The cost of construction is estimated at between $10,000,000 and $11,000,000. It is to be modeled after the North River tunnel here. It is understood that electric locomotives are to be employed in the tunnel.

LIGHTING IN MEXICO.—Advices from Mexico state that the *Diario Officiale*, the organ of the Government, announces the closing of a contract between President Diaz and Edward Dohenny, Charles A. Canfield and Norman Bridge, which grants to the latter a concession to erect and operate gas plants in any city or town in the Republic of Mexico. With the exception of Merida, there is not a gas plant in the republic. This is due to scarcity of fuel. Charcoal is the material universally used as fuel, and the manufacture of the product is rapidly destroying the forests. It was to preserve these forests that President Diaz granted the concession.

WIRELESS TRACKING OF FISH.—One of the large American fishing fleets has adopted wireless telegraphy as a means of keeping track of the schools of fish that haunt the Atlantic coast. The Fisheries Company controls the menhaden fishing industry of the coast, operating from Maine to Charleston, S. C., having factories centrally located at different points along the coast. It has forty steamers in its fleet and its object in adopting wireless is to get in closer touch with the fish as they traverse the Atlantic seaboard, as well as keeping in touch with its steamers from the shore. It will arrange to communicate with coastwise steamships equipped with wireless and in this way learn of the movements of fish that may be sighted by these coasting steamships. It will also be in position to use wireless to advantage in keeping its fleet posted. For instance, part of its fleet may be up around Sandy Hook cruising for fish, while the other part may be off Virginia, and in the event of their finding fish in either point, they could at the moment notify each other and all assemble without delay to the location where the fish are being caught. If the above installations prove satisfactory, the Fisheries Company will arrange to install wireless on the remainder of its fleet. Six steam vessels have now been equipped with the DeForest system.

MUNICIPAL OWNERSHIP.—Mr. Everett W. Burdett, counsel for the Edison Electric Co., the Old Colony Street Railway and many other quasi-public utility corporations, read last week at the Massachusetts Institute of Technology before the New England branch of the American Institute of Electrical Engineers, a most interesting paper on municipal ownership of lighting and street railway plants. His subject, "Public or Private Ownership of Public Service Utilities: Which is Preferable?" covered all phases of the problem, but Mr. Burdett confined himself almost wholly to the electrically equipped plants as they are at the present time receiving more public attention than any of the other enterprises. Mr. Burdett attacked the question from the theoretical, economic, practical and political standpoints, and gave an immense amount of statistics on the experiments in municipal ownership in England and in America. He said: "The subject of municipal ownership has recently assumed a new importance in this country. While it was previously debated in a more or less academic fashion, it has suddenly developed into a live political issue. Many of our people have turned in an inquiring frame of mind to the experiments in municipal ownership on the other side of the water. It has been found, and all of the leading journals on the other side will tell you, that municipal ownership has been a complete failure. The result has been in England that the vast majority of English towns that have engaged in such projects find themselves saddled with huge debt." Mr. Burdett showed by a mass of data that he had collected that the theory of municipal control has been riddled by the showing of the much vaunted municipal systems in Glasgow and other cities in England.

VALUE OF SCENERY.—Discussing the beauty of Niagara, and the effort made to utilize further the wasted energy there, the *New York Times* says: "The companies which destroyed the Falls of Montmorency are paying 7 per cent dividends on $24,000,000 of capital, with only $7,000,000 invested As cheap as coal or a little cheaper, is their motto. Niagara Falls would, of course, be of little value to the public, and of great value to the companies selling their power. The 600,000 tourist visitors at the Falls annually provide a widely distributed revenue of not less than $16,000,000. But if Niagara as a scenic spectacle brought in no revenue to the public, the United States could well afford to keep the cataract unimpaired. New York City alone keeps up Central Park, which is worth at the present real estate valuation $225,000,000. Now the total inflated capitalization of Niagara power enterprises is only about $40,000,000. Will Secretary Taft, representing the public sentiment of the United States, permit this great international park to be destroyed for their private benefit?"

UNDERGROUND TELEPHONE WIRES.—According to late advices the Delaware & Atlantic Telegraph and Telephone Co. has completed its conduit system between Wilmington and Philadelphia and it is now in use, the overhead wires having been abandoned so far as the trunk lines are concerned. Some of the pole lines will be retained for use as branch lines, for the convenience of settlements and subscribers along the route, but all of the through wires are now under ground. The company has about 200 trunk lines in the conduits, which gives it a splendid service. The underground system between Philadelphia and New York, built by the Bell Telephone Co., with which the Delaware & Atlantic is affiliated, is also finished and in use, which gives Wilmington an uninterrupted underground system to both Philadelphia and New York. The company is now planning an underground system between Wilmington and Washington and it has a force of men at work making the survey, which will probably be completed before severe weather sets in, and the company will, in all probability, construct the line next year. When this work is done, the Bell Telephone Company and the Delaware & Atlantic Telegraph and Telephone Company will have a complete underground system between the national capital and New York City, the metropolis of America. As soon as the tunnels under the North and East Rivers are completed the cables will be run under the rivers through them, thus giving connection with all of the boroughs of New York without an overhead break. It is understood that Pupin cables will be used.

A CROWDED THOROUGHFARE.—General Manager John F. Calderwood, of the Brooklyn Rapid Transit Company, has expressed the opinion that traffic conditions on the Brooklyn Bridge were becoming dangerous, and hinted that there might be a serious straining of the structure some day, if not a breakdown, unless improvements were made. Mr. Calderwood said he had no desire to alarm the public, but believed it his duty to state that his company was doing everything in its power to avert the threatened danger. It could not be held responsible for the present conditions. Mr. Calderwood asserted that in the operation of the bridge the limit of its capacity had been reached, and that there could be no improvement unless needed terminal and other facilities were provided or the Manhattan Bridge rushed to completion. "There is no transportation problem in the world," he said, "which is so complex or presents so many difficulties as the present operation on the Brooklyn Bridge, and the conditions are continually growing worse. We are now operating five-car bridge trains during the rush hours on a one-minute or better headway. Until a few weeks ago the best operation ever attempted there was four-car trains. Nearly 300 surface cars an hour are operated on the bridge. We are also operating during the rush hours about ninety six-car elevated trains around the terminal in Brooklyn. This is the limit of this terminal operation under present conditions. This, of course, governs the number of trains that can be operated on our elevated lines reaching the Brooklyn Bridge."

System of the Binghamton Light, Heat & Power Company, of Binghamton, N. Y.

ONE of the most progressive of the medium-sized electric light companies in the country is the Binghamton Light, Heat & Power Company of Binghamton, N. Y. The city in which it operates has a population of about 45,000 and is on the main line of the Lackawanna Railroad, being also reached over the Erie and the Delaware & Hudson Railroads. Two large rivers, the Susquehanna and the Chenango, pass through it so that the conditions for central station operation are favorable. The central station operated by the company is situated on Court Street, just east of the business section of the city, and has the tracks of the D., L. & W. R. R. on one side and the Susquehanna River across Court Street on the other side. The building is of brick and steel and has a basement in which all wires to the generators, exhaust piping and tanks, and piping for the oiling system are placed. Coal is delivered over a spur track from the railroad and a brick-lined well with a 30-in. intake from the river furnishes ample water for the boilers and condenser. Between the station and the tracks there is a storage-room for about 2,000 tons of coal. At present the coal is wheeled to the front of the boiler furnaces by barrows. A conveyor system has been under consideration; but as yet an uncertainty exists as to the economy of such an installation in a plant of this size. The boiler-room is 50 ft. by 77 ft., and the engine-room 50 ft. by 136 ft.

The boiler-room contains three Stirling water-tube boilers rated at 375 hp each, an American Blower Co. outfit for forced draft and the boiler feed pumps. The pumps are of the Stillwell-Bierce and Smith-Vaile make, outside packed. The boiler furnaces are fitted with McClave shaking grates and burn gas slack. One pump is used to pump water from the hot well to a Cochrane heater, and the other pumps the water from the heater into the boilers. All steam piping is in duplicate. One header is 6 ins. at the boiler end, and increases to 14 ins. in the engine-room; the other is 8 ins. in diameter and increases to 16 ins. The connections are such that all engines and boilers can be connected to either line. Expansion is provided for in long radius bends. The exhaust piping to atmosphere is 12 ins. in diameter. A by-pass allows a portion of the steam to exhaust through the feed-water heater. The exhaust pipe to the condenser from the large units is 24 ins. in diameter; the condenser is of the Alberger barometric type. The steam pipes are covered with a 2-in. pipe covering, and the exhaust pipe has a one-inch covering of the same material. Cochrane separators are fitted in all pipes leading to the main and auxiliary engines, the latter being fed through 4-in. lines in duplicate from the main headers.

The equipment in the engine-room comprises two 500-kw generating sets. One is a G. E. turbo-alternator unit and the other is a Pennsylvania Iron Works 20 by 40 by 42-in. Corliss engine direct-connected to a G. E. alternator. The generators deliver 60-cycle, three-phase current at a potential of 2,300 volts. A cross-compound Ball engine of 650 hp is belted to two 200-kw, three-phase generators, and a Ball tandem-compound engine of 275 hp rated output is belted to a 250-kw, 500-volt, direct-current generator. There is a 30-kw exciter unit driven by a Buckeye engine, and another exciter unit of the same output driven by an induction motor wound for primary voltage. A 500-volt generator of 150-kw capacity, driven by a 200-kw alternator used as a synchronous motor completes the electrical equipment. This latter set is reversible and can be used to supply either 500-volt, direct-current or 2,200-volt alternating current. The Corliss engine is fitted with a Monarch engine stop and speed limit device which can be operated from the switchboard and from several other points in the engine-room.

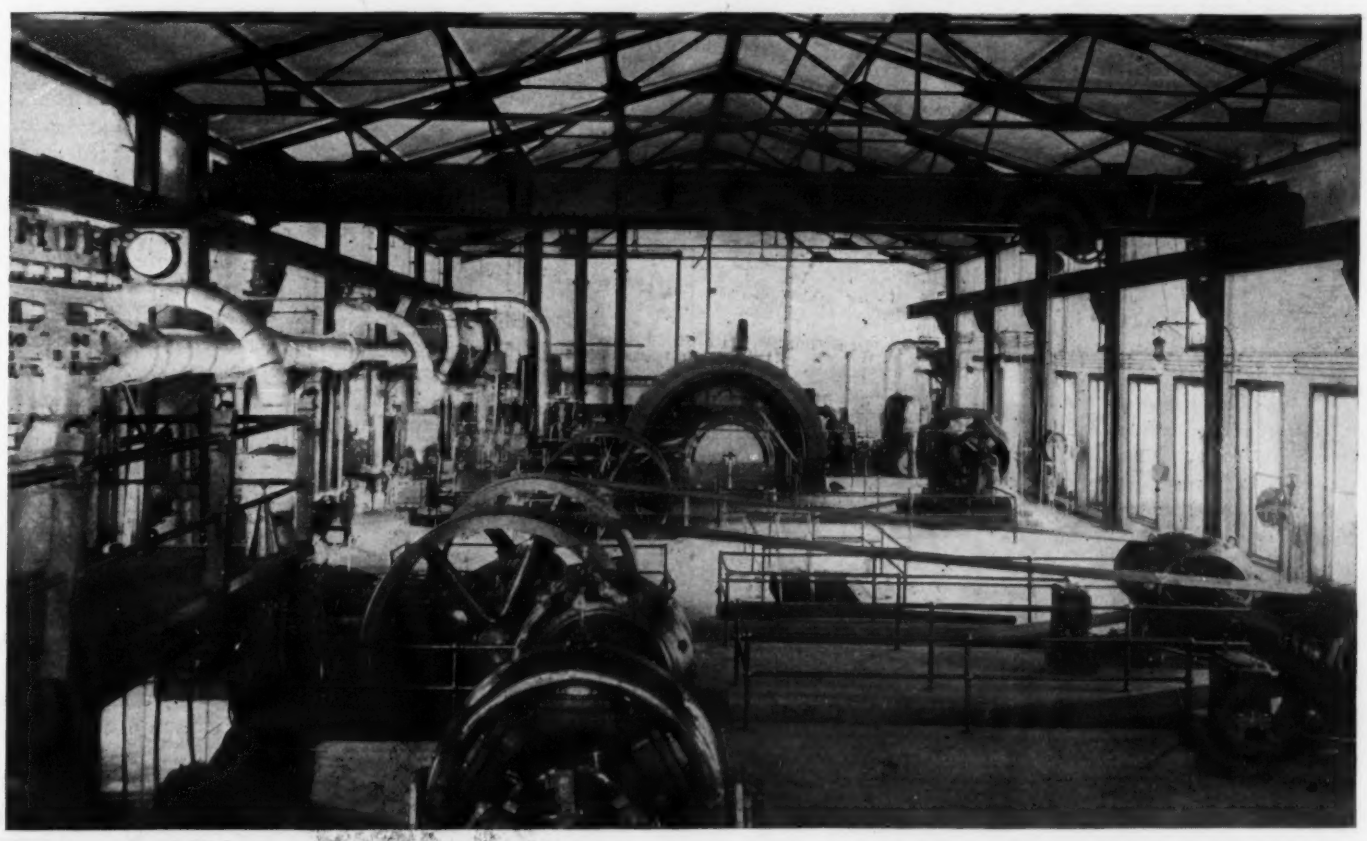


FIG. 1.—GENERAL VIEW OF DYNAMO ROOM, BINGHAMTON LIGHT, HEAT AND POWER COMPANY.

The switchboard was built and installed by the General Electric Company. It is of blue Vermont marble and has five generator panels, one panel for the two exciter units and a panel for the Tirrill regulator. Three panels control six single-phase feeders for the lamp and motor circuits. The 500-volt feeder switch is on the 500-volt generator panel. There is in addition one three-phase feeder panel and three panels for the series arc lighting system. The switchboard is on a platform elevated above the engine-room floor and overlooking it. The space below the board is utilized for six constant-current transformers, incandescent lamp circuit regulators and field rheostats. Each generator panel has the usual complement of switches and in-

struments. The former are double-throw, oil-break, connecting to either of two sets of three-phase busses. Four kinds of service are supplied from the board; single-phase and three-phase alternating current at a primary voltage of 2,200 volts; 550-volt

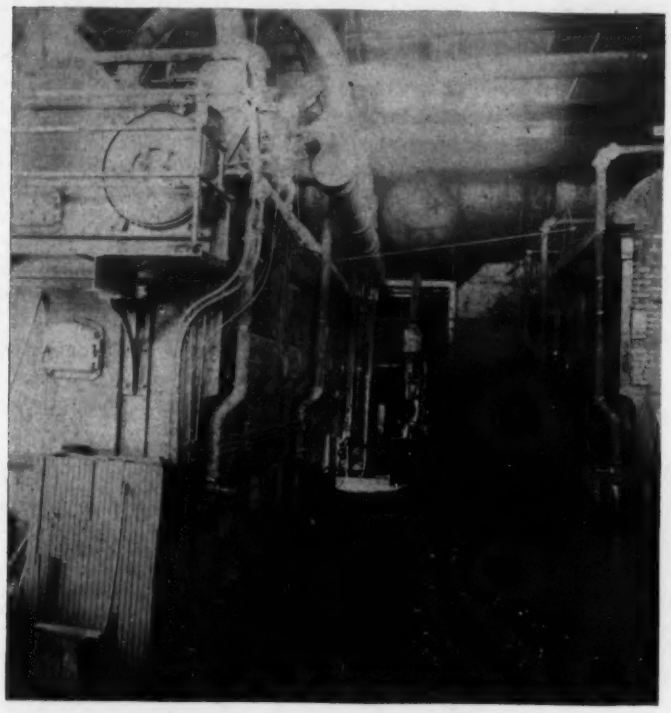


FIG. 2.—CORNER OF BOILER ROOM.

direct current for motors and the series alternating circuits for the arc lamps. Compensators are used with the voltmeters on single-phase feeders and also C. R. regulators. The output of each generator is metered, also the output of each feeder. Meters are installed on motor circuits, tub transformers, lamps, etc., using current in the station and a very complete report is made up every day of electricity generated, on what circuits it was used, station losses, weight of fuel used, etc. Every month a summary is made of the daily reports, known losses are subtracted from the electricity generated and the balance compared with the electricity sold on the several circuits as measured by the customer's meters. In this manner a very close check is kept on the operation of the station and the distribution system.

For street lighting G. E. series alternating enclosed arc lamps are employed taking 6.6 amperes. At present there are ten circuits controlling 435 arc and 448 incandescent lamps for street lighting. Five of the transformers are used to feed these circuits leaving a spare transformer for emergency use. The three-phase line was installed for motor service to the Chenango Silk Mill. Induction motors are used in the mill and several residences along the route are fed from the line. At present there are about 100 motors connected to the 500-volt, direct-current motor circuits; but the company is dropping as fast as practicable this class of service. The principal lamp and motor circuits of the company are served over six single-phase circuits. Each circuit has from one to four feeders and supplies a certain section of the city. Primary mains are run upon the various streets and are interconnected at corners. Secondary three-wire mains are run the same way and large transformers placed at intervals depending on the position of the load. This scheme is departed from somewhat in the case of isolated customers on the outskirts of the city. These are fed from separate transformers. About 450 hp in single-phase motors is installed, and up to the present no serious disturbance on the line has been caused. The system is all overhead and all service is metered.

Systematic inspection of lines is made by the superintendent, and a careful watch kept on the service by means of some half-dozen recording voltmeters. The location of these is constantly changed and the circuits readjusted when necessary. This is considered by the management to be of vital importance to good service.

Chief interest centers in the office system, and while there may be other systems in use which are better than that in use in Binghamton, we know of none that is as efficient when the question of cost is considered. The Binghamton Light, Heat & Power Co. is operating this end of the electric lighting business at a very low cost, and it is questionable if a system could be evolved which would be as efficient and at the same time as rigid in economy, which is an all-important item in the conduct of a small public service company such as the one under discussion. To get a maximum result with a minimum cost is the object of nearly all business-getting methods pursued by central station companies, and the Binghamton Light, Heat & Power Company has come as near to attaining this end as any central station company that we know of.

Labor in the station is divided into three parts—engine-room, boiler-room and switchboard—each set of men in a way independent of the other; each department keeping its own records and attending only to its own duties, but all working as a unit under the chief engineer. The chief engineer is responsible to the superintendent for the entire station operation, maintenance and character of service to the delivery of electricity on the feeders in the streets, where his responsibility ceases. The further delivery of electricity is in the hands of the maintenance or line construction force and the meter department.

Each department has a working foreman, who, keeping his own records, can be held directly responsible for the general efficiency of the work coming under his jurisdiction. Each foreman sends his report forms to the accounting department daily where they are properly classified and charged against the accounts to which they belong. All foremen report directly to the superintendent, who is in charge of all the company's employees except those in the accounting and sales departments; he is, therefore, responsible for all manufacture and delivery of electricity, maintenance, character of service rendered, daily and monthly operating reports, extension of lines, installing additions to equipment, and the general affairs of the company governing operation, but has nothing to do with the sale of electricity.

The accounting department is conducted by the auditor, who is also secretary of the company. The duties of this department

FIG. 3.—REAR VIEW OF SWITCHBOARDS, SHOWING WATT-HOUR METERS.

are billing, auditing, collecting, passing on credits, purchasing the supplies on requisitions coming from the several foremen through the superintendent, and making daily and monthly reports to the treasurer's office.

Contracts are turned in by the sales department to the auditor, who, after approving credits, submits them to the general manager for acceptance, and when approved and the certificate of the State Board of Fire Underwriters received, orders are issued to the construction and meter foremen through the superintendent for service and meter installation. The foremen return these orders to the superintendent properly filled in when the work is completed, showing expense of installation, and to which circuit it has been connected. The superintendent then passes the connection forms through to the accounting department and the applicant is entered in the books as a customer.

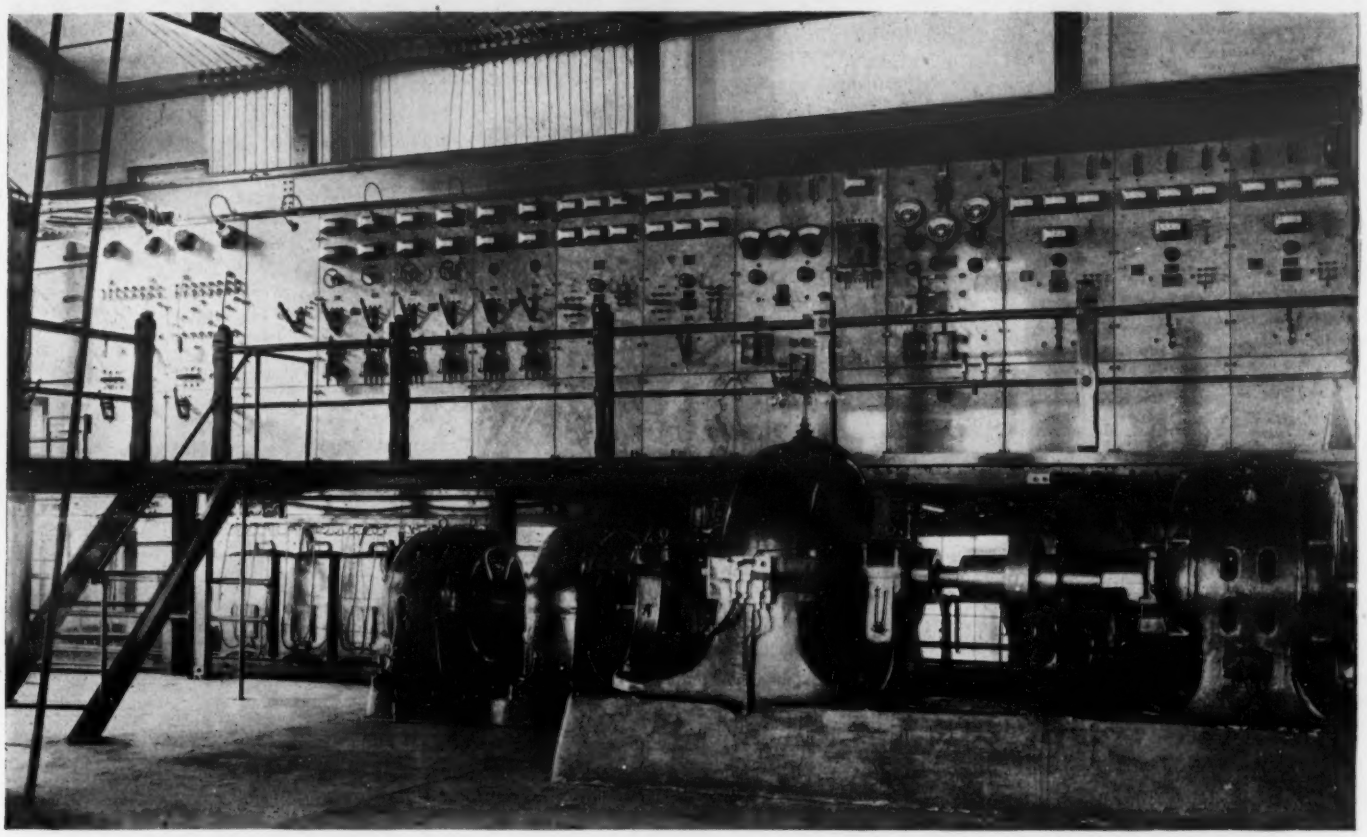


FIG. 4.—VIEW OF SWITCHBOARD GALLERY, SHOWING SYNCHRONOUS MOTOR-GENERATOR SET IN FOREGROUND.

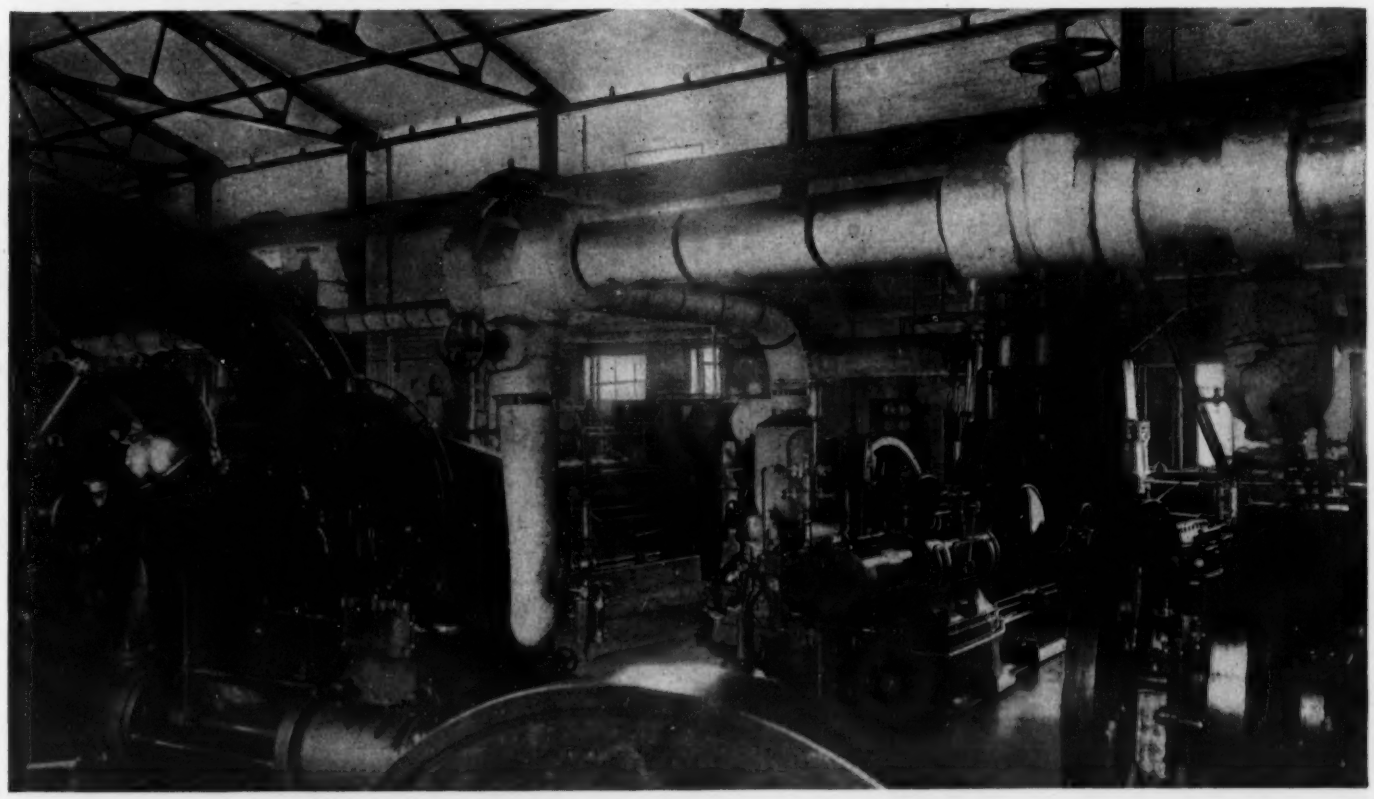


FIG. 5.—CORNER OF ENGINE ROOM, SHOWING THE MAIN ALTERNATORS.

Solicitors report each morning directly to the general manager the results of previous day's work; go over the files of business pending and take up any memoranda of special calls to be made; report difficulties or complaints encountered and compare notes on specific cases or general methods and results

Solicitors are in every case "home products" with a wide acquaintance and intimate knowledge of the temperament, characteristics and sentiment of the people. One of the solicitors has entree to the best social circles and events, and casually

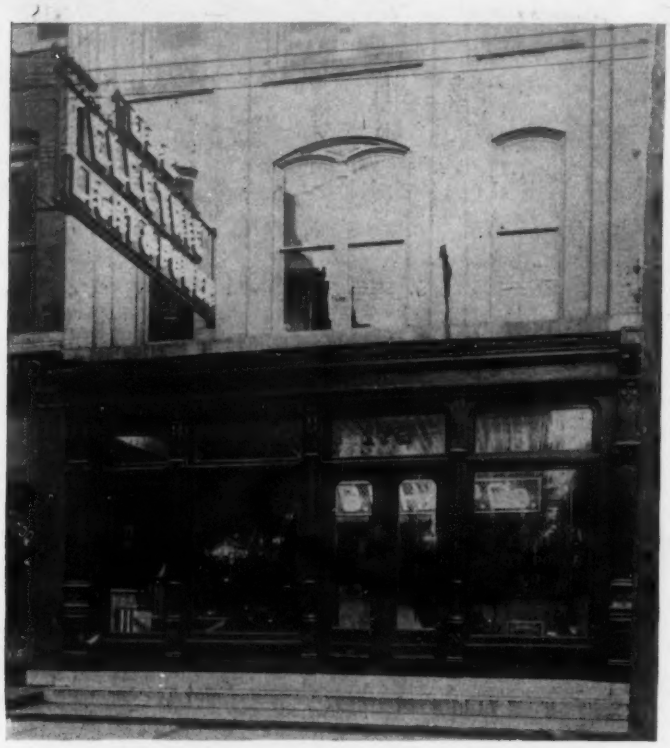


FIG. 6.—OFFICE OF THE COMPANY ON WASHINGTON STREET.

establishes in social intercourse an interest in the use of electricity, always avoiding, however, technical detail, leaving this part of the work and the actual closing of contracts to regular solicitors.

One of the schemes in cases where people are afraid that electric lighting will be too expensive, is to furnish service for thirty days on trial, the user having the option, at the end of that time, of paying for the energy consumed and discontinuing its use, or of signing a contract for a year and becoming a permanent customer. Of the numerous trial installations so far made 98 per cent have become permanently connected.

Another duty of this solicitor is to keep in close touch with public sentiment, and to report any antagonism or unfriendly spirit that may be due to misunderstanding or error, and that might be counteracted by special effort on the part of the management. This solicitor is in a general way familiar with electric devices of convenience, such as flat irons, cooking appliances and special lamps. The work is systematized as much as possible, but is in no way routine or of the kind or class done by the ordinary house-to-house canvasser.

For the convenience of regular solicitors in explaining different kinds of lighting, a demonstrating room is established where every kind of lamp, reflector, Holophane, and other glassware, fans, motors, electric irons, sewing-machine motors, cooking appliances and all utility and convenience devices pertaining to the electric light business is shown.

The demonstrating room adjoins the meter-room, and anyone who is interested is invited to inspect the meter-room and the methods of testing, calibrating and maintaining meters, the accuracy of which is seldom questioned if understood.

The company believes in assisting its solicitors with some form of advertising, and therefore has an arrangement with all the local newspapers whereby advertising space is utilized in a way which is rather unique and yet very successful. The company publishes what may be termed "combination ads" booming a customer's business and mentioning incidentally that he uses electric light. The free space is often used as an inducement to a prospective customer and at other times to a customer who will increase his energy consumption a specified amount or use his equipment in some way to the company's advantage. This method of free advertising is also used to great advantage in settling bill complaints, especially as the company has a fifteen-panel "talking sign" at the intersection of two of the principal streets, the space on which is handled exactly the same as that in the papers. This sign is used to tempt a prospective customer, to increase the connected load and to alleviate the rancor of a disgruntled customer when all other means fail. The newspaper and sign spaces are worked somewhat together, the papers calling attention to anything of interest on the sign and vice versa.

The method of pushing the electric sign business is as follows: The company puts out signs on the usual so-called "free" basis, i. e., combining the rental and energy charges in a flat monthly rate—the contracts all being made for a period of three years, at the expiration of which time the signs become the property of the customers. In advertising this part of the business the company proceeds first in a general way with its newspaper space and "talking sign" to get public notice; it calls attention to the signs inside and outside of its office building and has its solicitors make up a list of places which are in their judgment "ripe." To all on this list the company sends three letters at proper intervals, setting forth the advantages and attractive features of electric signs and using as reference the names of some sign customers, who have granted them that privilege. These letters are typewritten and addressed to an individual or one member of the firm, and are signed personally by the general manager of the electric light company. The sheet used is the company's regular letter head with the picture of the building front showing an electric sign. This is printed in tinted ink, so as not to interfere with the legibility of the typewriting and covers the entire page. To these letters are attached small photographs of attractive electric sign installations in the city. Enclosed with the letter is a return postal card bearing the photograph of some different electric sign in the city, on one end and on the other a request for a representative to call. The last one of these letters is immediately followed by a solicitor, who is much more likely to find the dealer in a receptive mood, than if no preliminary work had been done.

The company has a thousand Nernst lamp glowers in ser-

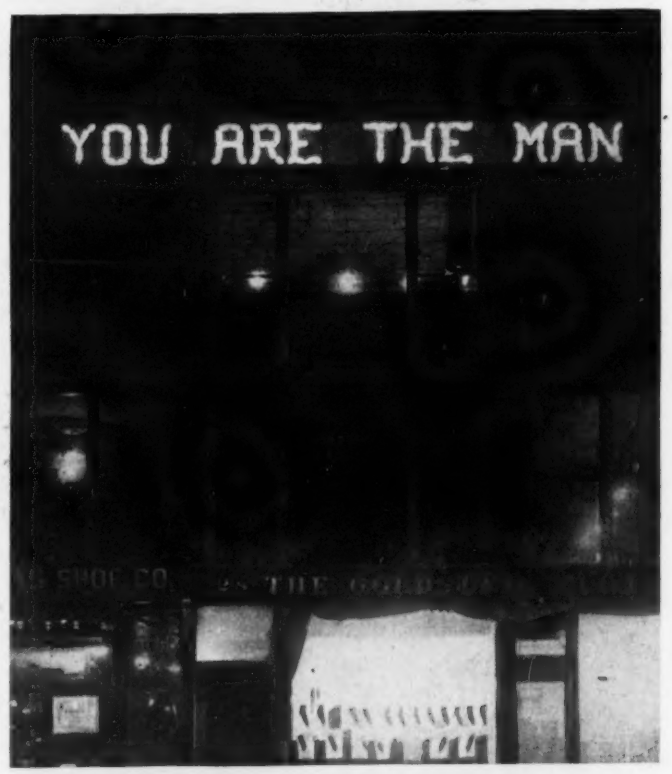


FIG. 7.—TALKING SIGN MAINTAINED BY ELECTRIC LIGHT COMPANY ON MAIN THOROUGHFARE.

vice. The attendants of these lamps have a combination repair and stockroom in which are kept all Nernst lamps, repair parts, maintenance route sheets and card file data relative to these lamps. This department, like all other departments, is charged with all Nernst lamps, repair parts and material for same. It

obtains new installation orders from the accounting department, makes daily inspections of the lamps in service and turns in records and requisitions for stock when necessary through the superintendent. Each lamp is numbered and this number and the location of the lamp, either in or out of service, is recorded in the card file, all maintenance material being recorded on the card bearing the number of the lamp on which it was used.

The arc lamp department is conducted in exactly the same manner, and the stock transfers from general to divided stock are made from these department records.

The company supplies both municipal and commercial lighting in the villages of Lestershire and Port Dickinson, which necessi-

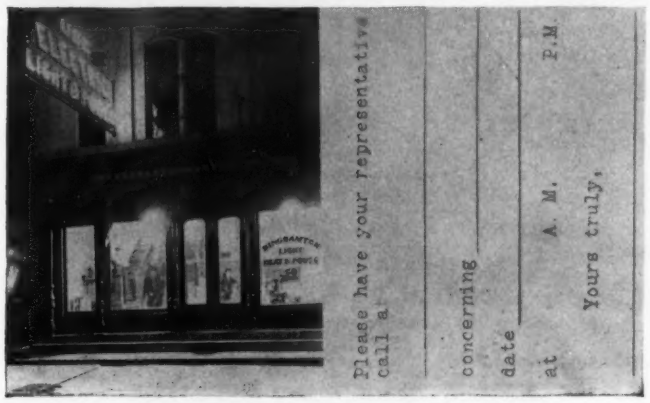


FIG. 8.—ONE SIDE OF RETURN POSTAL CARD.

tates a night patrolman who covers a large territory. The company has found on this work that the mileage is too great for a horse and has therefore substituted an electric vehicle with very satisfactory results, the "outage" being reduced to a trifling amount. This vehicle is also used in the daytime by the Nernst lamp and meter attendants, and is a great time-saver.

The management aims to give its employees all reasonable facilities to promote good and expeditious work—residence lighting, interior and exterior telephones and residence telephones to the general manager, superintendent, chief engineer, line foreman and Nernst lamp attendants—who are thereby always accessible to the public and to city officials.

The rates for commercial lighting range on a sliding scale basis from 15c. to 3c. per kw-hour, and for motor service from 10c. to 2c. per kw-hour. For municipal lighting the rate is $84 per arc lamp per year up to 400 lamps, and $80 per lamp per year for all in excess of 400. For street incandescent lighting a 105-watt series lamp, the rate for which is $21.50 per lamp per year. In Binghamton and Lestershire the service is all night every night in the year, and in Port Dickinson the service is from dusk to 1 a. m. every night. The rate for the latter town is $17.50 per lamp per year. The series incandescent lamps were installed to take the place of the gas and naphtha lamps previously used where the expense of an arc lamp was not warranted.

In addition to the card file records on the arc lamps, a map of street lighting lamps and circuits (separately from that showing commercial circuits, transformers and feeders) is kept on which each lamp location (both arc and incandescent) is shown and designated by a "location number." This enables one to see at a glance, by referring to the card file, where any lamp is located, what the maintenance has been, hours burned, etc.; in fact, to get the history of any one or all the lamps at any time.

Commercial arcs are handled in precisely the same manner as Nernst lamps. All arc lamps are changed regularly according to route sheets, a certain number being replaced each day, brought into the arc-lamp room, inspected, repaired if necessary, and put in proper condition before being rehung.

Simple card files are kept in the superintendent's office giving transformer locations and their data, poles by street and by consecutive numbers, and municipal lamps by streets and by circuits.

To insure absolute accuracy three sets of instruments are used for testing meters which are termed "Standards," "Bench Standards" and "Working Instruments." The standards are kept in locked safes in the meter-room, and only used by the foreman to check the bench standards. The working instruments are checked each morning by the bench standards before going out and each night when brought in. The standards are carried by hand at regular intervals to the factory, calibrated and certificate of correctness obtained—brought back by hand and put in the safes. This method insures absolute and unquestionable accuracy in meter testing, and when opportunity offers, is explained to the public.

The management believes that public approval is a very valuable asset to the company, and makes every possible effort to gain and keep this sentiment. Careful management, stringent economy and low rates with all possible publicity of methods is the policy of the company. The public in any community is often unreasoning, whimsical and suspicious, a composite of "many men of many minds." Getting the approval of enough individuals is getting the approval of the general public. The size of the income in a complaint case has, in the opinion of the management, no bearing upon the importance of keeping the good will of the customer, to say nothing of the fact that business saved is more profitable than business made, as the former is not accompanied by installation cost. Complaints are therefore treated with no reference or regard to the size of installation or revenue derived, as the company feels that it is in Binghamton to serve the public, and that any customer is entitled to and is welcome to as much of the company's time as he needs or desires. Courtesy, efficiency and progress are just as much necessary integral parts of the business, the company thinks, as the boilers or engines or anything else in the make-up of the equipment in attaining the desired prosperity. It is a pleasure for us to record our indebtedness to Mr. P. T. Glidden, the vice-president and general manager of the company, for courtesies extended to our representative in the preparation of this article.

Incandescent Lamp Clusters and Bowls.

By J. R. CRAVATH AND V. R. LANSINGH.

Fig. 1 shows the mean distribution of light in a vertical plane about a cluster consisting of six 60-watt spherical frosted bulb lamps, and one 120-watt lamp of the same type, consuming a total of 480 watts. This cluster has above it a white enameled metal reflector, as shown in Fig. 2. The central lamp has a white enameled prismatic reflector. It will be noticed it gives a good general distribution of light and can be used to advantage where a good light is required sideways as well as at other angles. The use of frosted lamps gives a soft mellow light and it is to be commended even at the expense of the life of the lamps.

Fig. 3 shows the distribution of light about a cluster with prismatic reflectors. This cluster contains six 16-cp standard clear

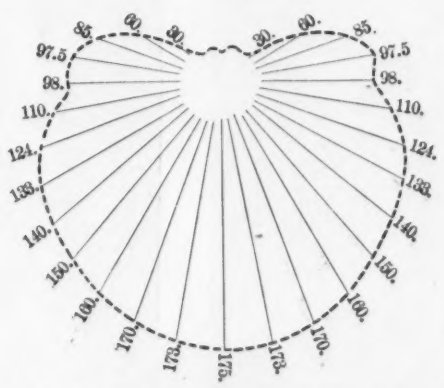


FIG. 1.—LIGHT ABOUT A 480-WATT CLUSTER.

bulb lamps, each lamp being in an individual prismatic reflector and the whole being surmounted by a prismatic reflector as shown in Fig. 4. This cluster has the advantage of using standard lamps of any desired candle-power and efficiency. In the curve given six 16-cp, 3.1-watt lamps were used, giving a total of 300 watts. Similar clusters of this type can also be obtained for

lamps of 32 to 50 cp. This type of cluster gives a strong downward light as well as a fair amount at other angles. It should

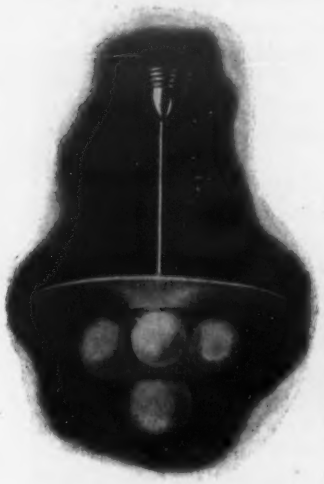


FIG. 2.—480-WATT CLUSTER.

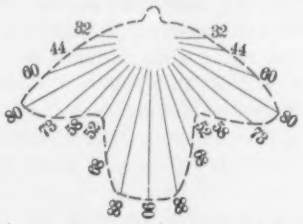


FIG. 5.—LIGHT ABOUT THREE-LAMP CLUSTER.

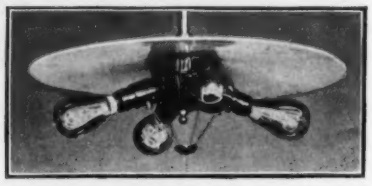


FIG. 8.—FOUR-LAMP CLUSTER WITH 19-IN. FLAT OPAL REFLECTOR.

be used with frosted tip lamps to cut off all view of the filament. It gains considerably in appearance by use of all frosted lamps.

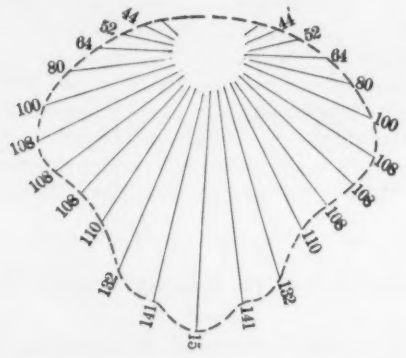


FIG. 3.—LIGHT ABOUT 300-WATT CLUSTER WITH PRISMATIC REFLECTOR.

Fig. 5 shows the distribution of light in a vertical plane drawn through the lamps from a three-light cluster with concentrating

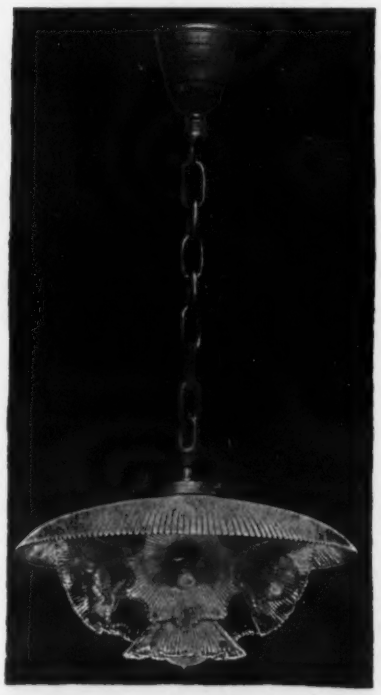


FIG. 4.—300-WATT CLUSTER.

FIG. 6.—THREE-LAMP CLUSTER.

prismatic reflectors. This cluster is shown in Fig. 6. It is specially suited to lighting corridors and similar places where light is to be thrown lengthwise of the corridor. It can be used with the bottom lamp omitted if it is not desirable to have as much light immediately under the fixture as in Fig. 5.

Fig. 7 shows the mean distribution of light in a vertical plane about a cluster of four 16-cp incandescent lamps under a flat

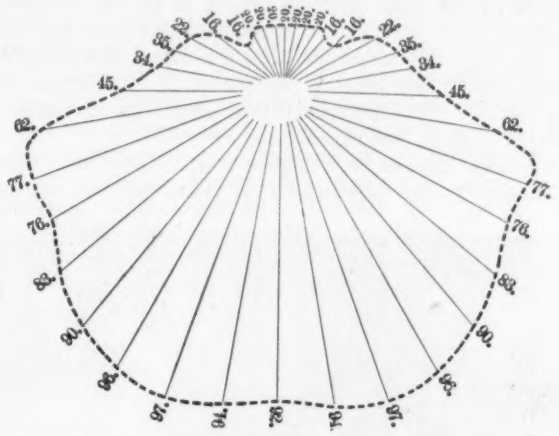


FIG. 7.—LIGHT ABOUT A FOUR-LAMP CLUSTER WITH 19-IN. FLAT OPAL REFLECTOR.

opal reflector, as shown in Fig. 8. This is a very common type of cluster, and gives a very good general distribution of light

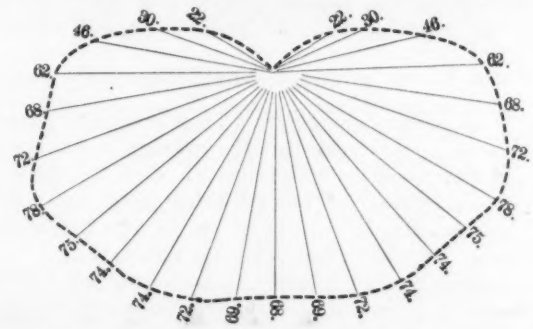


FIG. 9.—LIGHT ABOUT A FOUR-LAMP CLUSTER WITH ENAMELED METAL 19-IN. REFLECTOR.

below the horizontal, but casts a shadow on the ceiling. It should be used mainly for covering a large area. For securing

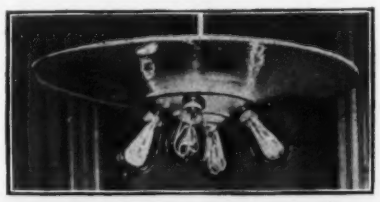


FIG. 10.—FOUR-LAMP CLUSTER WITH 19-IN. ENAMELED REFLECTOR.

light under the cluster or when placed close to high ceilings, especially in corridors, some of the other types shown are preferable. As the lamps are entirely exposed, such clusters should have frosted bulb lamps where hung low in the ordinary range of vision. Its chief objection for use in handsome stores, etc.,

FIG. 12.—FOUR-LAMP CLUSTER WITH PRISMATIC REFLECTOR.

is its entire lack of artistic appearance. It should only be used where appearance is of little value.

Fig. 9 shows the mean vertical distribution of light about a

cluster of four 16-cp incandescent lamps under a metal reflector shown in Fig. 10. The arrangement of lamps is such that the

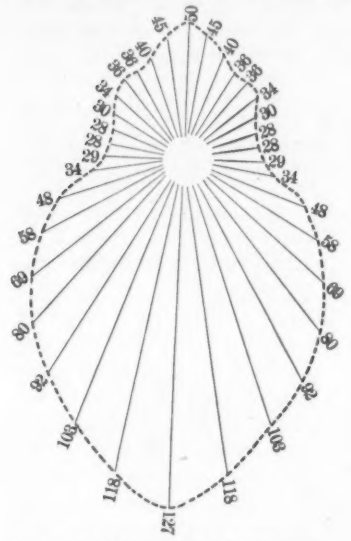


FIG. 11.—LIGHT ABOUT A CLUSTER OF FOUR 16-CP LAMPS UNDER PRISMATIC REFLECTOR.

amount of light escaping above and near the horizontal is much larger than is consistent with economy. It moreover has the

FIG. 14.—ROUGHED GLASS BOWL.

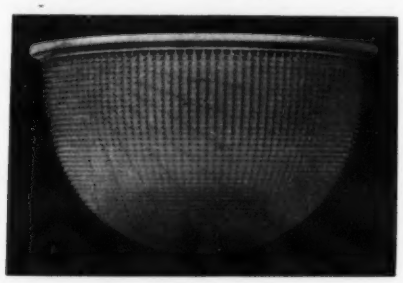


FIG. 16.—HOLOPHANE HEMISPHERE.

objection of casting a shadow on the ceiling and being inartistic in appearance.

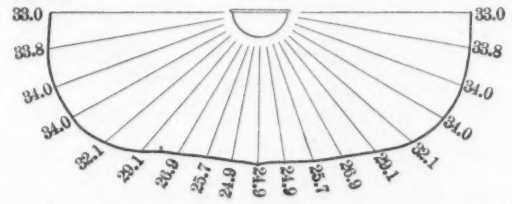


FIG. 18.—LIGHT ABOUT A GROUND GLASS BOWL WITH 50-CP LAMP.

Fig. 11 shows the mean distribution of light in a vertical plane about a cluster of four 16-cp incandescent lamps under a prismatic glass reflector, as shown in Fig. 12. This reflector is used by the United States Government in its buildings where clusters

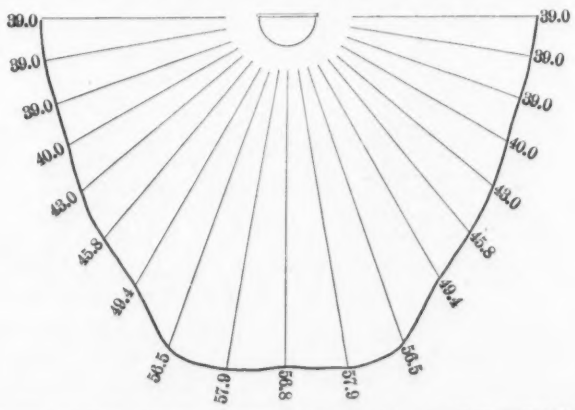
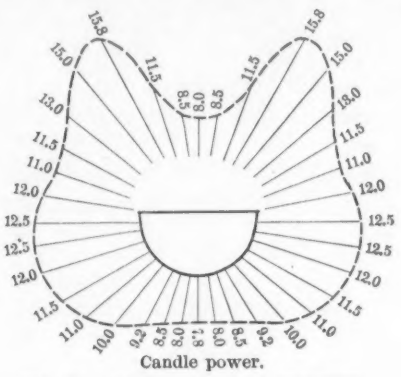
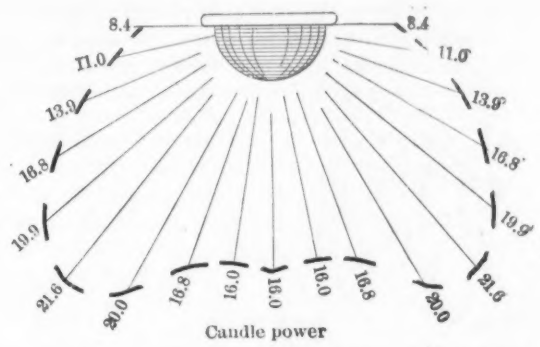


FIG. 19.—LIGHT ABOUT A GROUND-GLASS BOWL WITH PRISMATIC REFLECTOR 50-CP LAMP.



Candle power.

FIG. 13.—LIGHT ABOUT A ROUGHED GLASS BOWL.



Candle power

FIG. 15.—LIGHT ABOUT HOLOPHANE HEMISPHERE.

are needed, one of the principal reasons why it was chosen in preference to the opal reflector being that it does not darken the ceiling as much as the opal and gives more light immediately underneath over an area 30° each way from the vertical. It is also somewhat more pleasing in appearance. Unless placed

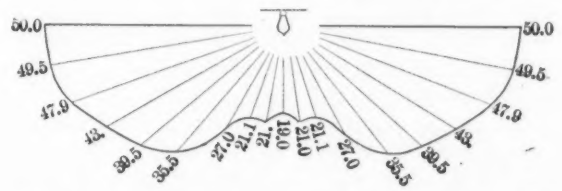


FIG. 17.—LIGHT ABOUT BARE 50-CP LAMP (LOWER HEMISPHERE).

high and out of the line of vision it should be used with frosted lamps.

The general application of clusters is in the lighting of places which have a limited number of outlets, where it is not practicable to distribute individual lamps over the area to be lighted. Clusters are not to be recommended for efficiency, as generally the

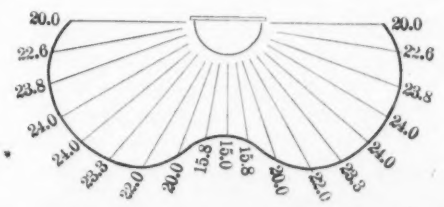


FIG. 20.—LIGHT ABOUT A BEADED BOWL WITH 50-CP LAMP.

same number of lamps distributed over the areas to be lighted would give better results for a given operating cost, although

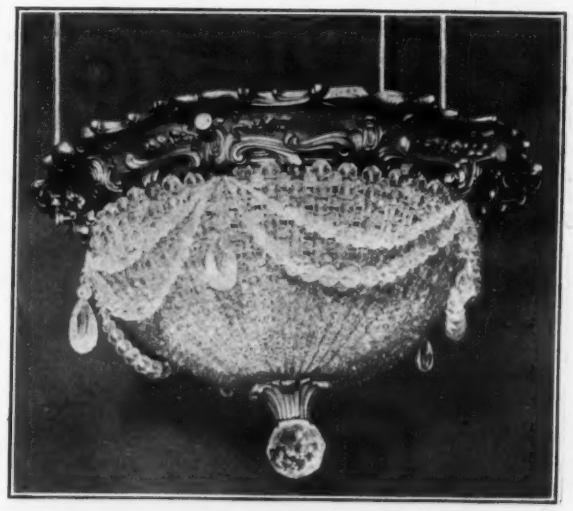


FIG. 21.—BEADED GLASS BOWL.

costing more to install. Some types of clusters can be installed at a lower cost than chandeliers of equal appearance.

BOWLS OR HEMISPHERES.

Fig. 13 gives the light distribution obtained from a sand-blasted glass bowl with a 16-cp incandescent lamp, shown in Fig. 14. Such bowls or hemispheres are frequently used for ceiling lamps and sometimes on basket fixtures. The sand-blasted bowl evidently acts somewhat as a reflector, as much light is thrown up. In practice this upward light would, of course, be thrown against

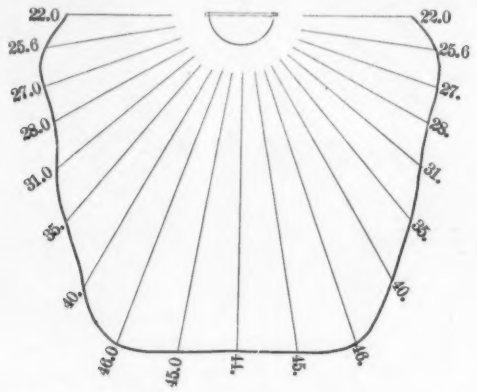


FIG. 22.—LIGHT ABOUT BEADED BOWL WITH PRISMATIC REFLECTOR.

the ceiling, and most of it would probably be absorbed unless a good reflecting surface was provided inside the bowl.

Fig. 15 shows the distribution of light about a 16-cp incandescent lamp placed in a Holophane hemisphere designed for use on ceilings and shown in Fig. 16. This test was made without a backing of white asbestos and consequently is comparable with Fig. 13.

As hemispheres and bowls are in such common use, it becomes of much importance to study the best arrangement of lamps inside of such bowls. The old plan of placing clusters of lamps at indiscriminate angles inside of these bowls is usually not to

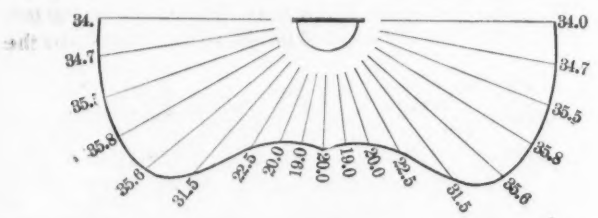


FIG. 23.—LIGHT ABOUT OPALINE BOWL WITH 50-CP LAMP.

be recommended. A single lamp of high candle-power generally gives better results than a number of smaller units, as such a lamp can be equipped with a reflector inside the bowl. When a cluster of lamps is used and each lamp is not equipped with its individual reflector, a piece of white asbestos, being a good reflector, should be employed. This should not be placed against the ceiling, but between the supporting rim and the glass, so as to bring the reflecting surface as close as possible to the lamps and avoid absorption by the rim, which would occur if the

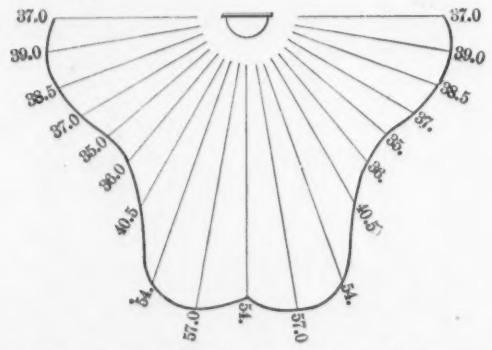


FIG. 24.—LIGHT ABOUT OPALINE BOWL WITH PRISMATIC REFLECTOR WITH 50-CP LAMP.

asbestos were placed against the ceiling. Such a reflector should be perforated with small holes, which will allow ventilation but effectually prevent light escaping between the ceiling and the rim, which often occurs if no reflector is used. The best arrangement, however, is to use one lamp of high candle-power equipped with either a concentrating or distributing reflector, depending on the way it is desired to throw the light. While the diffusing bowl undoubtedly alters the distribution from the lamp and reflector nevertheless the general characteristics are preserved.

Fig. 17 represents the light below the horizontal from a bare 50-cp oval anchored filament lamp which was used in the following tests on bowls. The tests without reflectors are not exactly

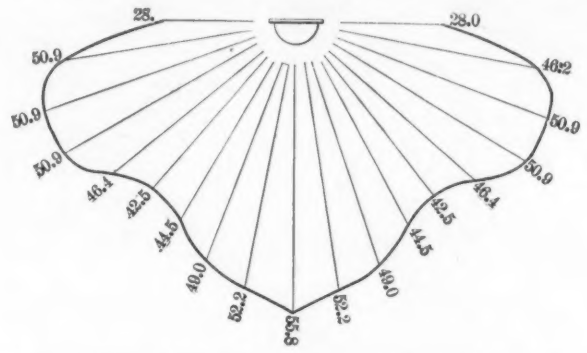


FIG. 25.—LIGHT ABOUT HOLOPHANE BOWL WITH 50-CP LAMP.

what would occur in actual practice, inasmuch as a certain amount of the upward light would be reflected if the ceiling were light in color. As, however, even a light ceiling quickly grows dirty owing to the particles of dust carried upward by the warm

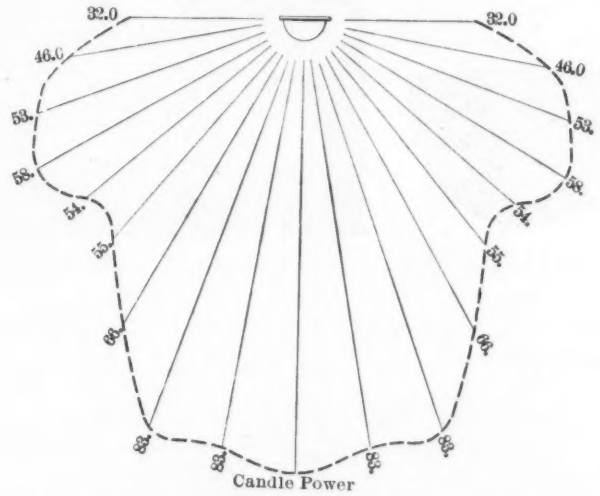


FIG. 26.—LIGHT ABOUT 50-CP LAMP IN 12-IN. HOLOPHANE BOWL WITH REPLECTOR.

currents of air, the tests referred to give a good idea of what actually happens in practice if no special attention is given to reflecting down the upward light.

Fig. 18 shows the light distribution from a 50-cp incandescent

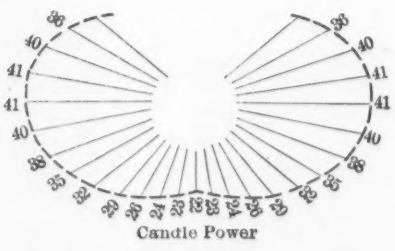


FIG. 27.—LIGHT ABOUT 13-IN. SAND-BLASTED BALL, 3 LAMPS, NO REFLECTORS.

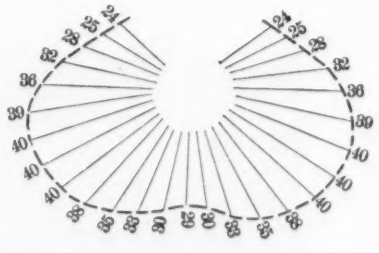


FIG. 28.—LIGHT ABOUT 13-IN. SAND-BLASTED BALL, 3 LAMPS, WITH REFLECTORS.

lamp in a 12-in. ground glass bowl, no reflector being provided on the lamp. The great increase in useful illumination by the use of a reflector over the lamp in the bowl is shown in Fig. 19. Fig. 20 shows the light distribution from a 50-cp lamp in a 12-in.

glass bowl covered with strings of glass beads, shown in Fig. 21. Such a bowl absorbs a great amount of light since the beads act as prisms to turn the light in various directions where it is lost by multiple reflection and refraction. Where cut glass beads are used around lamps in this manner, due allowance must be made, in this case about 50 per cent, for their high absorption by providing much larger candle-power in lamps than would otherwise be necessary.

The illumination from this beaded bowl, however, can be very much increased by the use of a prismatic reflector over the lamp, as is shown in Fig. 22, which gives the light distribution about the same beaded bowl with a reflector over the lamp. The increase in the total amount of light below the horizontal is 34 per cent and in the zone 60° each side of the vertical, which in hemisphere lighting is generally the most important, no less than 60 per cent.

Fig. 23 shows the light about a 50-cp lamp in an opaline 12-in. bowl, while Fig. 24 shows the light distribution when using a reflector over the lamp in the same opaline bowl.

Fig. 25 shows the light distribution from a 50-cp lamp in a 12½-in. Holophane bowl. While the downward distribution of light in this case is considerably greater than with any of the other bowls without reflectors on the lamps and is almost as great as when reflectors are used on the other bowls, the amount of downward light with the Holophane bowl can be greatly increased by the use of a reflector over the lamp, as is shown by the light distribution in Fig. 26.

It is sometimes possible when hemispheres, large balls and spheres already installed are placed high with a number of lamps in them, to put small reflectors on the lamps and so increase the downward light materially. This is not as good as having one large lamp and reflector, but is to be considered as a method of making the best of a bad arrangement.

Fig. 27 shows the mean distribution of light in a vertical plane around a ground glass ball 13 in. in diameter with three 16-cp lamps hung vertically in it without reflectors. The effect of adding small prismatic reflectors (3½ in. in diameter) over these lamps is shown in Fig. 28. It is probably possible to design smaller reflectors specially built for the class of work which would give better results.

All the tests given in this article were made by the Electrical Testing Laboratories of New York.

Transformation of Electric Power Into Light.

In a paper read at the November meeting of the American Institute of Electrical Engineers, Dr. C. P. Steinmetz gave an extremely interesting and instructive discussion of the physics involved in the transformation of electric power into light, and showed the limitations in the efficiencies which may be expected from the several types of electric lamps. It was pointed out that the main reason for the low efficiency in the incandescent lamp, or the ordinary carbon arc lamp, is that light is really a by-product; that is, the lamp converts electric power into heat, and only incidentally produces light.

Of the infinite variety of waves radiated by a heated body—from the long heat waves given by liquid air to the shortest ultra-violet waves, many octaves of wave length in all—somewhat less than one octave is visible to the eye. These wave lengths are useful as light; the rest is wasted energy. A parallel would be found in the case of a musical instrument of six or eight or more octaves, producing less than one audible octave. To this fact is due the very low efficiency of light production by heat; of the total system of radiation only a very narrow range is useful, less than one octave.

Of these useful rays, the visible three-quarters of an octave, none appears until the temperature is fairly high. Below that only the long waves appear. That means the average wave length of radiation decreases with the temperature. Or, with increase of temperature, not only the existing waves become intense, but shorter and shorter waves appear, and the intensity maximum moves toward a shorter wave length. With increase of temperature, the percentage of visible radiation thereby becomes greater and ultimately reaches a maximum, or the efficiency would be the highest when the maximum intensity lies just within the visible octave. Where this maximum may be, is unknown, but it is beyond the temperature of the crater of the arc, possibly somewhere between 4,000° and 5,000° C. At that temperature the specific power consumption of the incandescent lamp is a minimum, and probably from one-quarter to one-half watt per candle. Even then, however, the efficiency is not high, being about 5 or 10 per cent; 90 or 95 per cent is wasted in ultra-violet, chemical or actinic rays, X-rays, or long heat waves. There is thus an absolute limit to the efficiency of lighting by incandescence.

The higher the temperature the greater the efficiency of an incandescent body. Carbon is apparently the most refractory of all substances—its boiling point being about 3,500° C.—so that the incandescent crater of the carbon arc is the most efficient source of light by incandescence. In the case of the arc the temperature of the boiling point of the metal is reached, and the specific consumption is about one-half watt per candle. The efficiency obtained is less than the value here indicated, due to the heat conducted away by air currents.

In the case of an incandescent carbon filament, the limit of the temperature is not the boiling point, but is the temperature where evaporation of the filament becomes so rapid as to limit its life below economical requirements. This temperature is probably not far from 1,800° C., at which the filament evaporates, thereby decreasing in cross-section, and increasing in resistance; the current decreases, therefore the temperature decreases and the efficiency is lowered.

In the incandescent lamp the problem of increasing the efficiency can be attacked in two ways. One way is to replace the carbon by a material which has a lower vapor tension at high temperature. For instance, the metals osmium, tantalum, wolfram (tungsten) have a lower melting point or boiling point than carbon, but they have at the same high temperature a lower vapor-tension, due possibly to the much greater atomic weight and so much greater heaviness per molecule (atomic weight of carbon, 12; osmium, 191; tantalum, 183; wolfram, 184). These metals can be operated at a higher temperature than carbon, and as lamp filaments they give a much greater efficiency than the carbon filament.

The efficiency of the incandescent lamp can be improved by replacing the carbon filament with a material which has a lower vapor tension, and a sufficiently high melting point. Tantalum, osmium, wolfram or tungsten as materials for incandescent lamp filaments, promise to revolutionize the incandescent lamp, by holding out fair promise of an ultimate specific consumption of about 2 watts per mean spherical candle-power for tantalum, 1.5 watt for osmium, and 1 watt per mean spherical candle-power for wolfram—compared with about 4 watts per mean spherical candle-power for the carbon filament lamp. The objection to these metal filaments obviously is the low resistivity inherent to metals, which restricts their use to relatively larger units, as at least makes the production of low candle-power sizes very difficult.

Another way of improving the efficiency of the incandescent lamp is by improving the carbon. The vapor tension depends not only on the chemical constitution, but also on the physical structure. Ice evaporates very much more slowly than a mass of loose snow. Furthermore, it is possible to produce different forms, possibly allotropic modifications of carbon, of different rates of self-destruction. The product of carbonization of fibre or cellulose cannot be run at as high a temperature with the same length of life, as can carbon deposited from hydrocarbons, as benzol or benzine, by high temperature. Experiments with carbon at very high temperatures show probably greater variations in the character of carbon, than with any other material. Possibly this is due to the tendency which the carbon atom has more than any other atom, of polymerization, and especially ring formation, which results in the formation of allotropic modifications of carbon, having the greater stability of such polymerized molecules. So at the boiling point of carbon, the carbon deposited from hydrocarbons converts, under the influence of atoms which can enter and leave the carbon chain, into an allotropic modification having pronounced metallic characteristics, as elasticity, a positive temperature coefficient of resistance, etc., and very great stability, so that as a lamp filament this form of carbon can be run up to a considerably higher efficiency, in the so-called "metallized filament."

Most incandescent bodies give the same, or approximately the same, law of radiation, that of the so-called "black body"; that is, at the same temperature the intensity of radiation varies with the wave length or frequency in the same manner, with a maximum at a certain wave length. At higher temperature the maximum occurs at shorter wave length, or higher frequency, so that the intensity within the visible range is a higher percentage of the total radiation; that is, the efficiency of light production is higher.

If, however, a body could be found which gives an abnormally low radiation outside of the visible range, or which with normal radiation in the invisible range gives an abnormally high radiation in the visible range, then in either case the visible radiation would be a greater percentage of the total radiation than corresponds to the temperature; that is, the efficiency of light production would be higher than that of a black body at the same temperature. Theoretically such a body with selective radiation might give an efficiency higher than the absolute maximum of light efficiency of the black body radiation. Selective radiation may greatly increase the efficiency of inefficient illuminants, but not so much that of efficient illuminants, so that the hope of very greatly increasing the efficiency of light production by selective radiation of solids does not appear very strong. However, some of the recent very efficient incandescent lamp filaments, as tungsten and osmium, may owe their high efficiency partly to selective radiation; that is, they may give light not only by incandescence, but also by luminescence.

In discussing the electroluminescence of vapors and gases the author stated that heat, although capable of making a solid or liquid incandescent, does not make a gas incandescent or luminous, but merely increases its pressure. There are methods, however, of setting the gas molecules in vibration, such as by chemical reaction or electric stress. For instance, if the gas is used as a conductor of electric current, then the molecules are set in vibration and there is produced a definite period of vibration or a number of periods or frequencies, in which the gas molecules or atoms can vibrate; that is to say, gases give line spectra. The mercury vapor, for example, vibrates at that frequency which gives a particular yellow light, and a particular green light, etc., whether the temperature is high or low; the wave length is fixed by the nature of the molecule, so that the temperature has no direct effect. It has an indirect effect in so far as at high temperature, periods of vibrations may become more prominent, although small or almost non-existing at low temperatures. Now it happens that with mercury vapor at the higher temperature, a slower vibration, or longer wave length, of red light, increases in intensity faster than the short vibrations, and the light changes from green to white and ultimately to reddish pink at high temperature.

As a rule, then, it can be said that such an arc or a luminescent gas or vapor is more efficient as a producer of light, the lower the temperature. This is just the reverse of the solid incandescent body. In a gas or vapor a certain definite vibration is impressed directly by the electric power which sets up the oscillation; the heat which is produced is incidental, is a by-product and therefore a waste. The lower the temperature the less waste of power takes place as heat, and the more efficient is the luminescent gas. With a luminescent gas the heat is a by-product which we want to decrease just as in an electric motor or generator; that is, the lower the temperature, the better. This is one reason why the mercury arc is extremely efficient; it has the lowest temperature.

Theoretically, there is no limit to the efficiency of a luminescent vapor. A vapor may be imagined which vibrates only with one particular wave length, say a yellow line. That means all the power put into it must be radiated at that particular wave length, as yellow light, and therefore the conversion of electric power into light would be 100 per cent, not counting the power lost by heat convection or conduction. The latter can be made very small by enclosure in a vacuum. Complete conversion of electric power into light would so result, if all the spectrum lines were within the visible range. That is never the case. There is no definite law giving the percentage of power which appears as radiation in the visible spectrum, and which appears outside of the visible range as ultra-red and ultra-violet lines; but the position of the lines in the spectrum is an individual characteristic of the gas or vapor. The problem of efficient light production is to find a material having most lines in the visible range of the spectrum.

With mercury vapor which is set in vibration by the current, a very high percentage of the total power is radiated in the visible range. With carbon vapor the percentage of power radiated in the visible range is extremely small. The carbon arc is extremely low in efficiency, and is practically non-luminous. Silicon also gives a practically non-luminous arc. Others like calcium, titanium, etc., give a very high percentage of light within the visible range, and there is, therefore, a high efficiency of light production.

Within the last few years good efficiencies have been obtained with vacuum tube illumination. The mechanism of this light production seems not to be known. The production is extremely efficient with alternating currents of very high frequency. With decrease of frequency the efficiency decreases and heat is produced; that is, the frequency of radiation seems to vary with the frequency of the impressed e.m.f., and to have its intensity maximum near the visible range only at very high frequency currents. The production of light in the tube, therefore, seems to be connected in some way with the change of electric stress: it is not wholly dependent on it, because even with a steady current the tube gives light, but the efficiency of light production vastly increases with increase in frequency.

In the vacuum tube the current is carried by the gas or vapor which fills the space between the electrodes. The conduction is disruptive in character, or in the form of a spark discharge; that is, a minimum voltage is required. Below this voltage no conduction takes place; above it the current passes, with the appearance of luminescence; and if the voltage falls below the minimum value that is required to start conduction, the current again ceases. The material of the electrodes has no direct effect, but the spectrum is that of the gas between the electrodes. The character of the current also seems to have no direct effect; alternating current passes at about the same voltage as direct current.

An entirely different set of phenomena is met in arc conduction. The electric arc makes its own conductor. That is, the current is carried across the gap between the electrodes by a vapor bridge, produced by the current from the material of the negative electrode and maintained by the current as a high-velocity vapor stream issuing from the negative towards the positive, and more or less surrounding the positive terminal. The spectrum of the arc, therefore, is that of the negative terminal, but independent of the gas or vapor filling the space around it, or of the material of the positive terminal, except indirectly by the effect of heat, etc.

The continuous production of the vapor stream requires power in raising the negative material to the boiling point, evaporating it and producing its rectilinear velocity. This power must be supplied by the electric circuit, as a potential drop at the arc terminals, independent of the length of the arc, and of the current—if the volume of the vapor stream is assumed as proportional to the current, which seems to be the case. This potential drop may be called the counter electromotive force of the arc.

The temperature of the arc stream, at constant pressure in the surrounding space, must be constant—that of the boiling point of the material of the negative terminal. The power radiated per unit surface may, therefore, be also assumed as constant, and the total power radiated and therefore the power consumed in the arc stream, as proportional to its surface; that is, to the product of length by diameter. Since the section of the arc stream can be assumed as proportional to the current, it follows that the voltage consumed by the arc stream is inversely proportional to the square root of the current, and approximately proportional to the arc length, or, when allowing for the abstraction of power from the arc stream by the terminals, proportional to the arc length plus a small constant quantity. Experiments confirm these theoretical deductions.

From the character of arc conduction—that the current makes its own conductor—it follows that the arc must be started; that is, the vapor bridge which carries the current must first be produced by the expenditure of energy before the current can flow.

This can be done in many ways: by bringing the terminals in contact with each other and so starting the current, and then by withdrawing the terminals from each other to form the arc stream by the current; or by jumping an electrostatic spark across the gap and so starting conduction.

It also follows that the arc is a direct-current phenomenon, and in general cannot exist with an alternating current. With an alternating electromotive force at the end of the half wave, the current dies out and therefore also the vapor stream; and the next half wave, to pass in opposite direction, requires a vapor stream moving in the opposite direction. This does not exist and the current does not pass; but the arc dies out at the end of the half wave, except if the supply voltage is sufficiently high to jump a spark across the terminals at every half wave, through the residual vapor left by the preceding half wave. An alternating arc, therefore, must be at every half wave in the condition for starting by a spark. Stroboscopic photographs with metal arcs show this phenomenon: a sharply defined static spark at every half wave, gradually spreading out to the more diffuse arc flame and then dying out at the end of the half wave, to start again by a spark at the next half wave.

The voltage required to maintain the vapor stream—that is, the voltage consumed by a direct-current arc—increases with increase of the arc temperature; that is, increase of the boiling point of the terminal material. It is lowest for the mercury arc, highest for the carbon arc. The voltage required to jump a spark across the gap between terminals decreases with increasing temperature. Above a temperature of about 3,000° C. the spark voltage is below the arc voltage, and a voltage sufficiently high to maintain an arc is sufficiently high to start it again at each half wave of alternating e.m.f. That is to say, materials as arc terminals which have a boiling point above a certain temperature maintain a steady alternating current arc at about the same voltage as a direct-current arc, while materials with a lower boiling point require a higher voltage, usually very many times higher, to maintain an alternating, than a direct-current arc. It must be considered, however, that the temperature of the boiling point. while being the foremost factor, is not the only factor. Individual characteristics somewhat modify the results.

Where, therefore, spark-gap terminals are desired not to maintain an alternating arc, as for lightning arrester cylinders, they are found among the so-called "non-arcing" metals—mercury, cadmium, zinc, antimony, bismuth. Where electrodes for alternating-current arc lighting are required, they are found among a different class of substances. In this range belong carbon and most carbides, as those of calcium and titanium. Even carbon shows the phenomenon of restarting at every half wave, by a high peak at the beginning of the electromotive force wave. Immediately below the dividing line of the materials are found very refractory metals, as tungsten and metaloxides, as those of titanium, etc. In case of materials lying much below the dividing line, the arc stream forms a unidirectional conductor, of very low resistance in one direction and of practically infinite resistance in the opposite direction. While vapors like mercury, zinc, etc., are very good conductors when in motion under the influence of the current, of a conductivity comparable with that of electrolytes; when not under the influence of the current they are almost perfect insulators, and so can be distinguished from the so-called "conducting gases," as hydrogen, air, etc., as "non-conducting vapors." Low temperature metal vapors thus are non-conductors.

The spectrum of the arc is that of the negative material; its temperature that of the boiling point of the negative. There are, however, some apparent exceptions. For instance, the arc stream can be superheated by using a high-frequency oscillating current of sufficiently high voltage to maintain an alternating arc, and a frequency so high that a sufficient vapor stream cannot be formed during the half wave. In this case groups of spectrum lines frequently become prominent, which are insignificant with saturated vapor: the mercury arc becomes bright red in color; the iron arc loses most of its brilliancy, but gives a great quantity of intense ultra-violet rays, etc. Likewise, the spectrum of the positive, or a constituent of the positive terminal, can be made to appear in the arc.

The tip of the positive is heated to the temperature of the vapor stream—in the carbon arc the temperature of boiling carbon. If the positive terminal consists of, or contains some material which boils below the temperature of the vapor stream, then it will evaporate out of the positive, and may thus enter the arc stream. For instance, in a carbon arc, or arc with carbon as negative, if a carbon is used as positive, impregnated with calcium fluoride or borate, which has a relatively low boiling point, then the calcium vapor enters the arc stream and is thereby heated to the temperature of the carbon arc. It becomes luminescent, whether directly by heat or indirectly by chemical dissociation, or otherwise, need not be considered here. So the efficiency of a carbon arc can be increased by feeding into the arc flame the vapor of some material which gives a brilliant spectrum—as calcium, which gives a yellow light of very great brilliancy. It is fed into the arc by the positive terminal, because this is the hottest, and the efficiency depends entirely on the temperature of the positive. If the positive is very large, so as to keep cool and consumes slowly, the efficiency decreases, because it is produced only indirectly by material being evaporated from the positive and then as vapor entering the arc stream. Therefore, a high temperature and rapid consumption of the positive are necessary.

It is entirely different with the true luminous arc, which carries the light-giving material into the flame by the electric current, as the vapor blast, which carries the current. The carbon as negative material is objectionable, since it gives the non-luminous carbon arc. Iron appears to be a very suitable material, since it gives a spectrum extending over the whole visible range. It produces practically a white light. The positive can then be maintained cold without affecting the brilliancy or efficiency of the arc. The negative can also be cooled without appreciable effect on the efficiency, since the current still produces the vapor blast from it, and so the light. If cooled too much the voltage in the arc may rise a little, because it requires more energy to produce the iron vapor from the cool negative than from the hot negative, but still the efficiency is not much affected.

There are, then, two distinct ways of producing luminescence of the arc: first, directly by using some material as negative which gives a luminous spectrum—that is, a spectrum with many lines in the visible range, preferably covering this whole range—to get white light; secondly, indirectly by using some material to carry the current which gives a very high temperature to the arc stream—which means practically carbon—and making the arc stream luminous by feeding some light-giving substance into the arc from the positive terminal. In the former case the arc has the characteristic of the iron arc or titanium arc, whatever material is used; in the latter case, it has the characteristic of the carbon arc.

Since the carbon arc is the steadiest arc, the most work has been done in the latter direction. The former method, of feeding the luminescent material by the current from the negative material, has the advantage, however, that the efficiency does not depend on the temperature of the electrodes: the rate of consumption of the negative electrode can thus be greatly decreased by maintaining it at low temperature, while the positive electrode, which takes no part in the arc conduction, can be made entirely non-consuming. This method seems to be a more direct conversion of electric power into light.

These two forms of arc have come into prominence recently: the flame carbon arc and the metal compound arc; that is, an arc in which carbon is not used, but some other material which gives a luminous spectrum, as iron or titanium. In the former case the characteristics are those of the carbon arc. All the materials which can be used to increase the efficiency of the carbon arc—calcium compounds are used almost exclusively—deposit as solids after passing through the arc flame, and therefore ventilation must be provided to carry off the smoke; that is, the arc must be a so-called "open" or "burning" arc. The life of the electrodes is about 10 hours. Flame carbon arcs, therefore, have short-life electrodes, though their efficiency is high. Again, efficiency has to be balanced against life, or decreased cost of energy against increased cost of electrodes and attendance. Here in the States the short-burning arcs for street lighting have practically disappeared. Indoors the excessive brilliancy and the

smoke are objectionable, so that the flame carbon arc does not offer much prospect for general illumination.

More prospect of success appears to exist in the true luminous arc, an arc using as negative a material giving an efficient and brilliant spectrum. Such material should give lines uniformly distributed not only in the green or yellow, but over the whole visible range, and the material should not be attacked in air, even at high temperature. The arc must be an open arc, since the material deposits are solid, and to get electrodes with long life a material is required which is stable at high temperature in the air.

There are very many metals which give luminous spectra, but those which give white are substantially the metals of the iron group only—iron, titanium, wolfram, etc.

Long-burning quality requires a material which is not affected, or only little affected by the air. This, in general, excludes the metals, but requires a stable oxide or other fairly stable compound, as some carbides are. It should also be a conductor, since as arc electrode it has to carry the current. In the intermediate oxide of iron magnetite (Fe_3O_4), a material is found which is a good conductor, is stable at high temperatures as well as at low temperatures and gives a white spectrum. In such an electro luminescent arc any stable material is suitable as a positive terminal. Copper is generally used because it is cheap, is stable at fairly high temperature, is a very good conductor of heat, and when heated by the arc carries the heat away with sufficient rapidity not to melt or oxidize appreciably. In all these arcs the vapor stream from the negative is a necessity. In the mercury arc it is easiest of observation, because the arc is enclosed in a glass tube.

The amount of vapor produced by the current from the negative is usually many times greater than necessary to carry the current, and most of it can be condensed without any appreciable change in the arc stream. So also magnetite consumes at a much greater rate than is necessary, or an order of ¼ gram per ampere-hour. This rate of evaporation is greatly reduced by the addition of small quantities of a material which is chemically not much different from magnetite, but is much more refractory; so that at the temperature where the magnetite melts this material is still solid and forms a kind of sponge in which the melted magnetite is held and its consumption greatly retarded.

Magnetite, however, while a good conductor of the arc stream, is not very efficient as a producer of light, and added thereto are other materials which give a very high efficiency, as titanium compounds.

In the magnetite arc—as used at present, that is, in which the magnetite electrode contains titanium oxide, etc.—magnetite is essentially the carrier of the arc conduction, just as carbon in the yellow-flame arc; titanium with its highly efficient white spectrum takes in the magnetite arc the same place as calcium in the flame arc, as light-giving substance, but titanium is carried into the arc stream by the current from the negative, while calcium in the flame arc enters by evaporation from the positive.

The elimination of carbon in the magnetite arc excludes combustion, and this increases the life of electrodes to about twenty times that of carbon electrodes under the same conditions; but just as with the carbon arc, the efficiency of the magnetite arc can be varied over a wide range, with a corresponding variation of life in opposite direction. That is, by sacrificing some efficiency the life can be greatly increased, or the efficiency can be increased by somewhat reducing the life, by increasing the percentage of light-giving material: usually titanium oxide in the magnetite arc, calcium fluoride or borate in the flame carbon arc. In either case, a very high percentage of the light-giving material tends to the formation of a non-conducting slag at the electrode surface, and if the lowest possible consumption is desired—¼ watt per cp, and better—the effect of the non-conducting, or poorly-conducting electrode surface has to be eliminated, by starting the arc from the side of the electrode, or some other method.

Magnetite, titanium oxide, and most metals or their compounds do not maintain a steady alternating arc. For alternating arcs, therefore, one of the materials is required to be in the range of carbon, carbides and similar compounds.

Thus the titanium arc with alternating current cannot use magnetite as carrier, and titanium oxide as light-giving material; but titanium carbide is used as arc conductor. It obviously is not so incombustible as the oxide, but still so much more stable than carbon as to be well within the range of long-burning arcs.

To conclude, then, in the luminous arc we seem to have the first instance of a commercial application of a direct conversion of electric power into light, without heat as intermediary form of power. It is not limited to very low values of efficiency. But so far it seems that only the green mercury spectrum, the yellow calcium spectrum, and the white titanium spectrum offer an efficiency so vastly superior to that of incandescent solids, that as regards the efficiency of light production no possible improvement in incandescent lighting could hope to approach it. Typical of these three most efficient spectra are the mercury arc lamp, of practically infinite life and bluish-green color of light; the yellow flame carbon arc of the short life of the open arc lamp of old, and the white titanium carbide or magnetite arc, of a life equal to or greater than that of the enclosed carbon arc.

Central Station Work at Rutland, Vermont.

In common with many other communities in Vermont the city of Rutland enjoys transmitted power generated by hydro-electric methods. The work of the Chittenden Water Power Company in building a large storage reservoir and erecting a power plant near by in the Chittenden Valley of the Green Mountains has already been described in this journal. but comparatively little has as yet been published in regard to actual central station work in Rutland, which is a keen business rival of Burlington, and which is the commercial center of a population of about 23,000 people, including Rutland, West Rutland, Castleton, Hydeville and Fairhaven.

Electric lighting has been pushed more or less in Rutland since 1885, and the present organization, formed in 1906, represents several important consolidations. The central station work in the city was first carried on by the Rutland Electric Light Company, 1885; the Marble City Electric Light Company followed in 1887; next came the Marble City Electric Company, 1894; and in 1897, the Rutland City Electric Company. This year all the electrical public service interests in the power, railway and lighting lines were consolidated in the Rutland Railway, Light & Power Company, which is composed of the Rutland Street Railway Company, the People's Gas Light Company, the Chittenden Water Power Company and the Rutland City Electric Company. A process of centralizing the equipment and business methods is now taking place, and it is expected that by January 1, 1907, all the public service in these lines will be unified, power being drawn from the hydraulic plant of the Chittenden component company, described in the latter part of 1905 by the Electrical World. Under the managership of Mr. George S. Haley, the recently elected president of the Vermont Electrical Association, the central station company brings to the consolidation a thoroughly progressive operating organization. The officers of the Rutland Railway, Light and Power Company are: President, G. Tracy Rogers, of Binghamton, N. Y.; vice-president. Leo H. Wise, of New York City; secretary and treasurer, C. H. West, Rutland; and general manager, David Fox, Rutland.

At present, pending the completion of the sub-station equipment in Rutland, the central station service of the company is supplied by a 1,000-hp steam plant in the city itself. It is unnecessary to describe this plant at length as the equipment features are not as modern as those of the new power system, but the service furnished consists mainly of 2,300-volt, 60-cycle supply, and 500-volt power on a direct-current basis. The arc lighting of Rutland is thoroughly modern in the use of 6.6-ampere enclosed alternating-current lamps. The use of coal at $4 per ton, however, with belted engines and generators, and non-condensing engines at that, is scarcely to be considered now that the water power has been developed, and the completion of the entire Chittenden reservoir scheme will mean ample power supply the year through, even allowing for a large growth in the demand at Rutland. The new water power plant, which is located at Mendon, four miles northeast of Rutland, contains three 400-kw, 13,200-volt, 25-cycle, three-phase, revolving-field

generators direct driven by three S. Morgan Smith turbines operating under a head of 200 ft. A total head of about 500 ft. in addition to this remains to be developed in the future. The power house and the Rutland sub-station represent a present investment cost of about $125,000.

Between the Mendon power house and Rutland two three-phase transmission lines of No. 4 copper are run, the line potential being 13,200 volts. The pole lines are separate, being spaced on the average 100 ft. from each other. From Rutland to Castleton an 11-mile line carries power to a sub-station at the latter point. At present the Rutland sub-station contains three 125-kw air-cooled 13,000 to 380-volt step-down transformers, two 150-kw, 600-volt rotary converters for railway service and a 400-ampere-hour Gould storage battery of 284 cells which absorbs the fluctuations of the railway and power systems. An addition to this sub-station, which is to be built with concrete blocks, is to contain a 500-kw, 60-cycle to 25-cycle, 13,200 to 2,300-volt frequency changing set to enable the Mendon station to properly handle the power and lighting load in Rutland. Three 150-kw, 25-cycle, 13,200 volts to 2,300-volt transformers will also be installed to enable 25-cycle power to be delivered in Rutland.

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LOCATION	LIGHT OUTLETS WIRED				SWITCH OUTLETS WIRED			Total
	Chand.	Brks.	Lts.	Cost	No.	Kind	Cost	Cost
Porch								
Vestibule								
Hall								
Parlor								
Library								
Sitting Room								
Dining Room								
Kitchen								
Pantry								
Cellar								
Bath Room								
Bed Room								
" "								
" "								
" "								
Barn								
							Grand Total	

FIG. 1.—ONE SIDE OF WIRING ESTIMATE CARD.

power station two 12-hour shifts are run. The distributing circuits from the completed Rutland sub-station will include a 2,300-volt, 25-cycle, three-phase line, a 600-volt railway direct-current supply, 600-volt, direct-current motor circuit and 2,300-volt incandescent and arc lamp leads. The frequency changer will supply the arc load also, by sending 60-cycle current through three 50-light tub transformers.

At the time of the writer's visit to Rutland the company had 786 central-station customers, and all but 13 of these were supplied with electricity on meter rates. The connected incandescent load aggregated 15,432 16-cp equivalents, 164 6.6-amp. street arcs, 154 4-, 6- and 7.5-amp. commercial arcs and in motors, 395 hp in direct-current machines and 50 hp in alternating-current motors. In fan motors and electric flatirons there were 584 16-cp equivalents. The largest motor which will probably be allowed on lighting circuits when the plant is completely reorganized is 5-hp three-phase and 1-hp single-phase. The company's circuits cover 25 miles of streets, and the policy is to connect up any customer within the limits. In fact, one of the lines is a 3-mile lighting circuit for farm consumers. The public is encouraged to visit the new water-power plant, although this is not easily reached except by team or automobile.

New business is constantly solicited by an employee who gives practically his whole time to the work. Newspaper advertisements are changed every week and printed matter is often sent to customers with monthly bills. About 20 electric signs are in service in Rutland on lighting rates. Very large signs are operated on separate meters. High-efficiency lamps are being introduced to a considerable extent on the system.

Lighting rates are 15 cents per kw-hour for the first two kw-hours consumed per lamp socket and the first twenty kw-hours per arc lamp. Excess is charged for at 7.5 cts. per kw-hour. Rates for motor service are 5.5 cts. per kw-hour between 0 and 599 kw-hours, decreasing to 2.48 cts. on the excess above 3,000 kw-hours and 2.2 cts. on the excess above 10,000. The minimum lighting rates are $1 per incandescent lamp on meters, $2 per arc lamp per month, and $1 per maximum motor hp. Ten per cent discount is allowed on all lighting bills paid by the 10th of each month.

Complete card systems are used to facilitate the office work. One of the most interesting is a "Wiring Estimate Card" reproduced herewith, which gives a complete record of the outlets, switches, fixtures and shades desired by each new customer. An attractive exhibiting room is fitted up in the office for the display of different styles of lamps and shades. Customers make their selections here, and as each selection is determined, it is recorded on the card, and the estimate of cost made up on this basis.

LAMP TRIMMER'S WEEKLY REPORT.

Week Ending._____190

	CARBONS, COMMERCIAL ARC				STREET ARC		GLOBES, COMMERCIAL ARC						STREET ARC	
	SOLID		CORED		SOLID	CORED	INNER		OUTER		SHADES		INNER	OUTER
	7-16 x 9	1-2 x 9	7-16 x 9	1-2 x 9	1-2 x 9	1-2 x 9	CLEAR	LT. OPAL	CLEAR	LT. OPAL	9 x 15 1-2		LT. OPAL	CLEAR
MONDAY														
TUESDAY														
WEDNESDAY														
THURSDAY														
FRIDAY														
SATURDAY														
SUNDAY														
TOTAL														

Trimmer

FIG. 2.—LAMP TRIMMERS' WEEKLY REPORT BLANK.

used with the storage battery. Soft and hard coal mixed are used in the present steam plant, city water being used in the boiler. Coal is brought to the plant by rail, but manual handling is employed. One or two boilers are kept banked in the daytime, ready to respond to increased loads on the station. At the water-

INSTALLATION REPORT.

Rutland City Electric Co.

_____ 190 _____

Name _____ Address _____

Wired during construction _____ After _____

Kind of Work. Cleat, Concealed or Moulding _____

LOCATION	LIGHT OUTLETS		INC. LAMPS				SWITCH OUTLETS		
	NO.	Kind of Outlet	4	8	16	32	No.	Kind	Floor or Plate
PORCH									
VESTIBULE									
HALL									
PARLOR									
LIBRARY									
SITTING ROOM									
DINING ROOM									
KITCHEN									
PANTRY									
CELLAR									
BATH ROOM									
BED ROOM									
BARN									
MISCELLANEOUS									
TOTAL									

Motors _____ H. P. _____ Voltage _____

Arc Lamps _____ Amp. _____ Kind _____ Shade _____

Ready for Service _____ 190 _____ Connected _____ 190 _____

Installed by _____

FIG. 3.—INSTALLATION REPORT BLANK.

The company, of course, does inside wiring. The 700 meters on the company's circuits are read in three days by two men. Special blanks and cards are in use for meter records, meter readers, meter installations, time slips, tests, stock and materials used. An excellent lamp trimmer's weekly report is also used, covering carbons and globes for commercial and street arcs, inner globes, outers and shades.

It is interesting to note that the People's Gas Light Company, the Rutland Street Railway Company and the Chittenden Power Company have never paid interest on bonded indebtedness, their total capitalization being $2,750,000, with a bonded indebtedness of $1,650,000. The new Rutland Light and Power Company was organized in March, 1906, with a bond issue of $1,200,000 and a stock issue of $1,500,000, and on September 1 the company paid its first coupons, expended about $75,000 on improvements and are now practically out of debt. The price of gas has been reduced from $1.60 to $1.35, and the earnings are now more than sufficient to pay all fixed charges. Dividends will probably be paid in the near future. The directors of this new company are, besides Messrs. Rogers and West, Mr. G. T. Chaffee, of Rutland, and Mr. L. W. Blandwin, president of the Empire Trust Company, New York.

Recent Design in Direct-Current Switchboards.

By Edward Schildhauer.

In the past few years interest has naturally centered more on high-tension, alternating-current switchboards for large electric light and power systems than on the direct-current switchboards used in the sub-stations of such systems. This is due to the fact that alternating-current practice has been in more of a formative stage than direct-current practice. There have, however, been marked improvements in the design of direct-current switchboards for supplying Edison three-wire, direct-current networks in our large cities. It is the purpose of the present article to describe some of the recent practice of the Chicago Edison Company in direct-current switchboard design

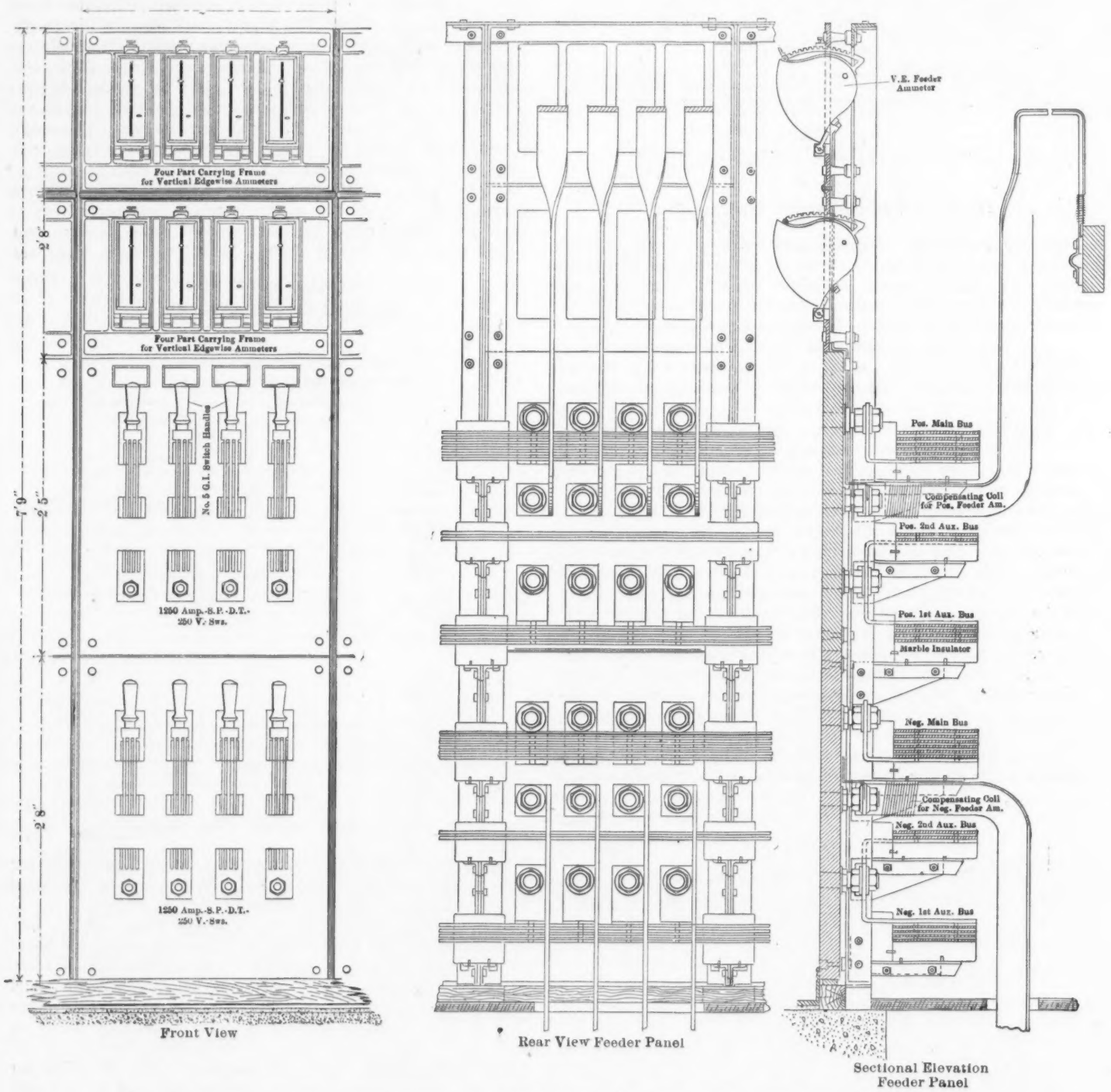


Fig. 1.—Front and Rear Elevations and Cross-Sectional Elevation of 1250-amp. Feeder Panel.

Up to within two years ago it had been the practice of this company as of others to place the bus-bars in a vertical position parallel to the marble panel. In the latest design, however, in order to secure the best separation of potentials and at the same time have the rear of the switchboard as accessible as possible, the bus-bars are placed horizontally, as shown in the accompanying illustrations. A front, rear and side elevation of such a feeder panel is shown in Fig. 1. The appearance of the front of the board has not been altered from that of previous designs, but the copper work in the rear has undergone a radical change. In

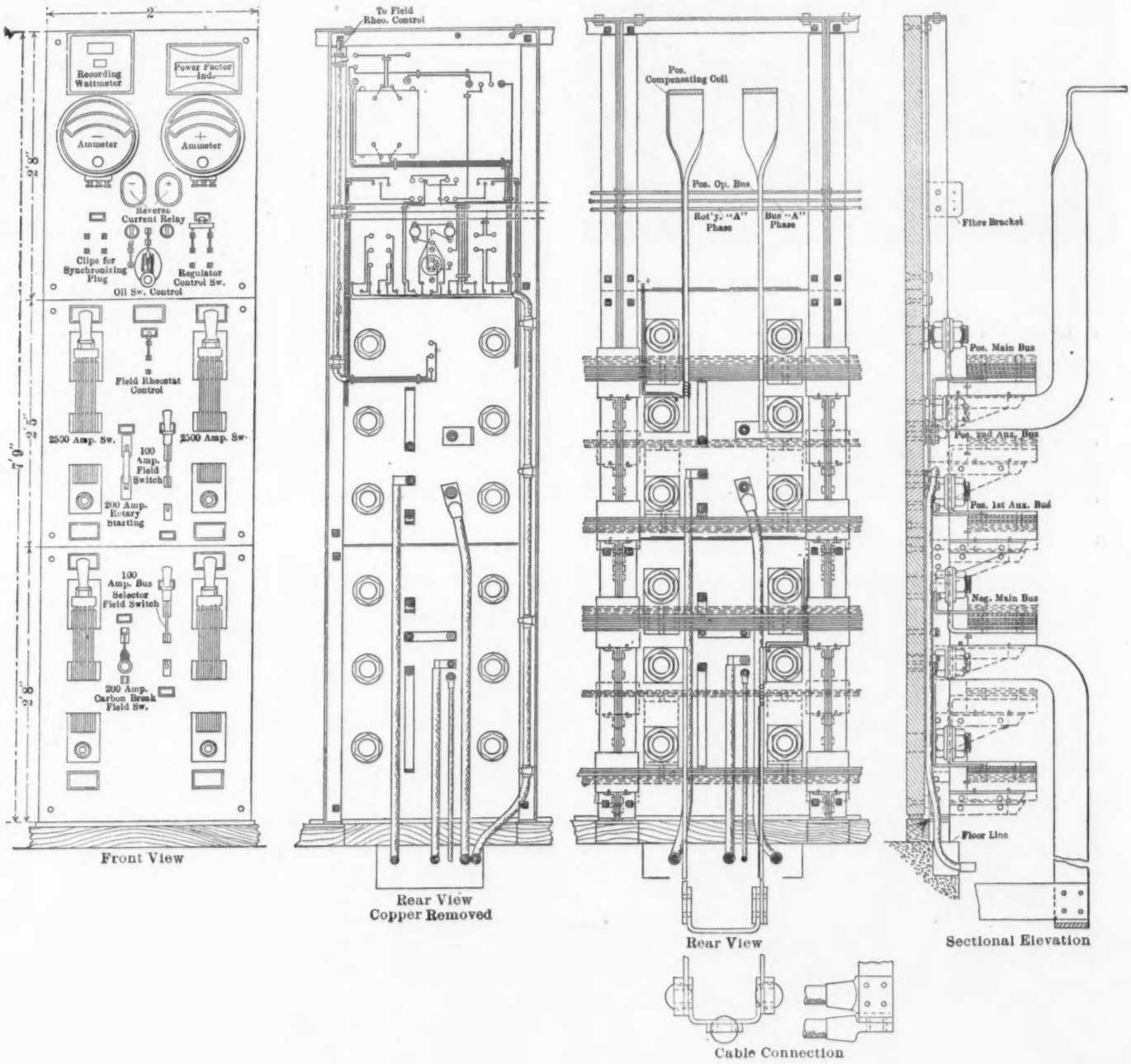


FIG. 2.—ELEVATIONS AND SECTIONAL VIEW OF 1000-KW ROTARY PANEL.

erected than the immediate needs demand, because the interest on the money invested in copper and labor on the first installation, when everything is "dead," is small in comparison with the cost of labor of increasing the cross-section of the bus-bars when this has to be done on "live" switchboards. Work of this kind can only be trusted to mechanics of long experience and, therefore, only the best construction men are available. In the old design where the bus-bars were placed vertically the ventilation is better than in the new where the flow of air must be horizontal in order to dissipate the loss in the middle bars. However, since the previous constructions the bus-bar copper was placed vertically. This necessitated two bends in the copper from switch stud to bus-bar. It also involved the difficult bending of copper from the center stud of the double-throw switch which is connected directly to the feeder.

In general the cross-section of bus-bars is a matter which cannot be calculated accurately, and knowledge obtained by experience has to be applied. It is, therefore, essential that the bus construction should be such that the cross-section may be increased as the growth of business demands. Good practice dictates the installation of more copper in the switchboard when cross-section of copper should always be liberal the heat to be dissipated is small, and, therefore, the difference in loss, due to ventilation, can be neglected.

In the new construction there is but one bend in the copper from switch stud to bus-bars. The same tie from the first auxiliary to switch stud will also fit the second auxiliary connection, so that in order to change a feeder from first auxiliary to second, or vice versa, it is only necessary to remove the bolts securing the tie to bus and one nut from the switch stud. The tie can then be readily removed and reversed. Although the cost of labor for making the long copper bar from center stud of switch

to fuse panel is more in this construction, it is balanced by the cost of the necessary cable racks and training of feeder cables in older designs. This same bar can generally be made of sufficient length to use for the ammeter shunt by applying a compensating coil for temperature corrections. The foregoing advantages are only incidental. The principal advantage is that all studs, nuts and bolts are readily accessible. With a socket wrench, having insulated stem and handle, a mechanic can tighten any bolt on the panel.

FIG. 3.—INTERIOR OF A PARTIALLY COMPLETED SUB-STATION.

Fig. 2 shows front, rear and side elevations of a rotary converter panel for units of 1,000 kw capacity. This panel is designed for a diametrically connected rotary converter with the common point of the transformer connected through a switch to the neutral of the three-wire system, therefore requiring two ammeters to measure the total output of the rotary converter. For rotary converters above 1,000 kw capacity, the knife switches become cumbersome, and remote controlled switches are advocated. Fig. 7 shows a combined arrangement for battery and booster balancer panels, which occupied a width of eight feet in the earlier switchboards, but is now reduced to five feet. It will be seen that the studs, nuts and bolts are as accessible in these as in the feeder and rotary converter panels. The following figures show at once the advantages of the design just described.

Fig. 3 shows the conditions where a sub-station had to be erected and in operation by a definite date and where the electrical construction was delayed by building operations. Two 1,000-kw rotary converters were installed and ready for service thirty-five days after the first electrical material was delivered. Fig. 4 shows a switchboard built according to the latest design. In this sub-station the energy is sold at the switchboard and for this reason watt-hour meters are installed between the rotary converter and feeder panels. This switchboard will accommodate five 1,000-kw rotary converters and twenty feeders, but can be readily extended by adding more panels. Fig. 5 shows this sub-station with three 1,000-kw rotary converters, installed complete. Fig. 6 shows a side view of the switchboard from the feeder end in which the bus location from top to bottom is as follows: Positive main, positive auxiliary, negative main, nega-

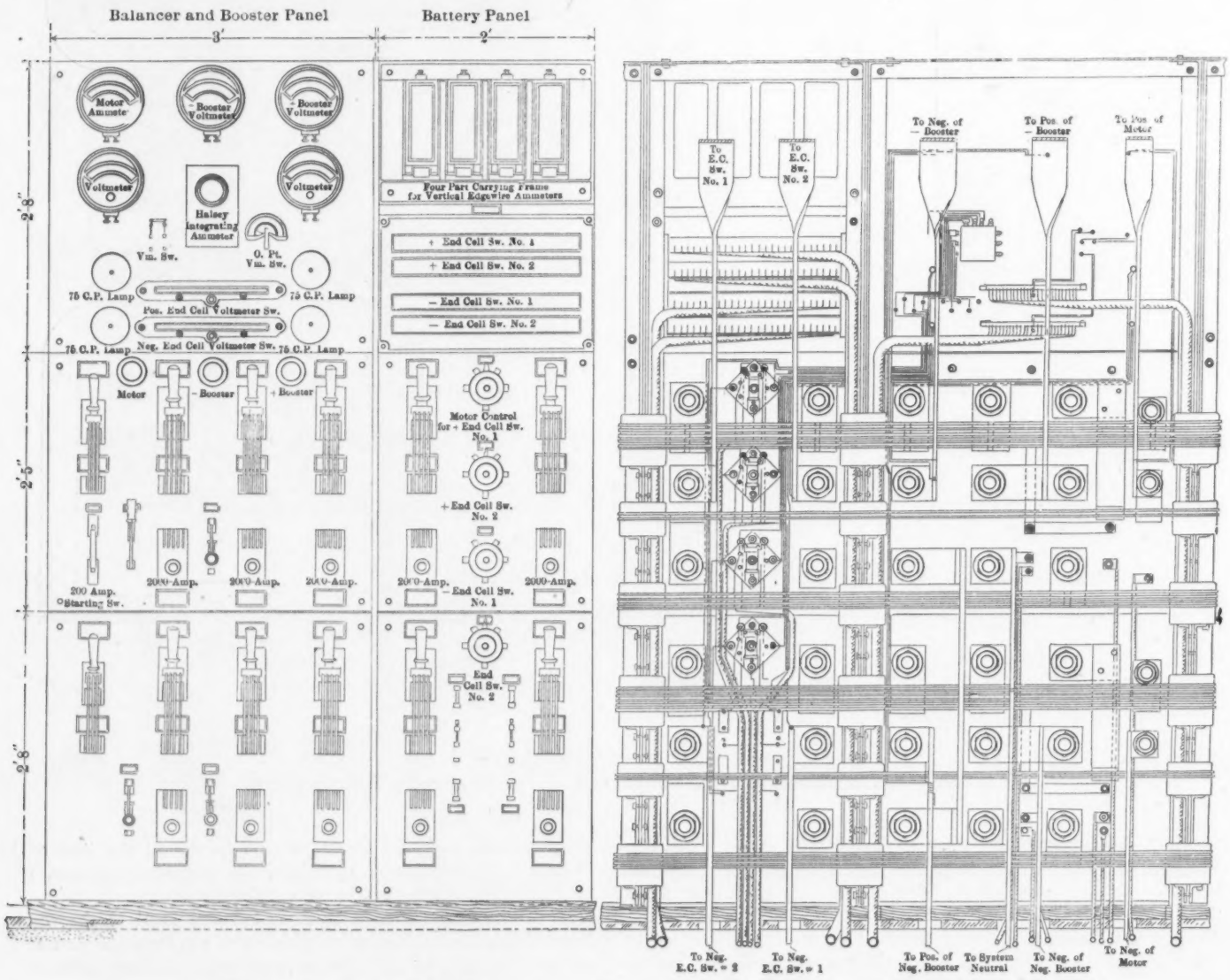


FIG. 7.—FRONT AND REAR ELEVATIONS OF BATTERY AND BALANCER AND BOOSTER PANELS.

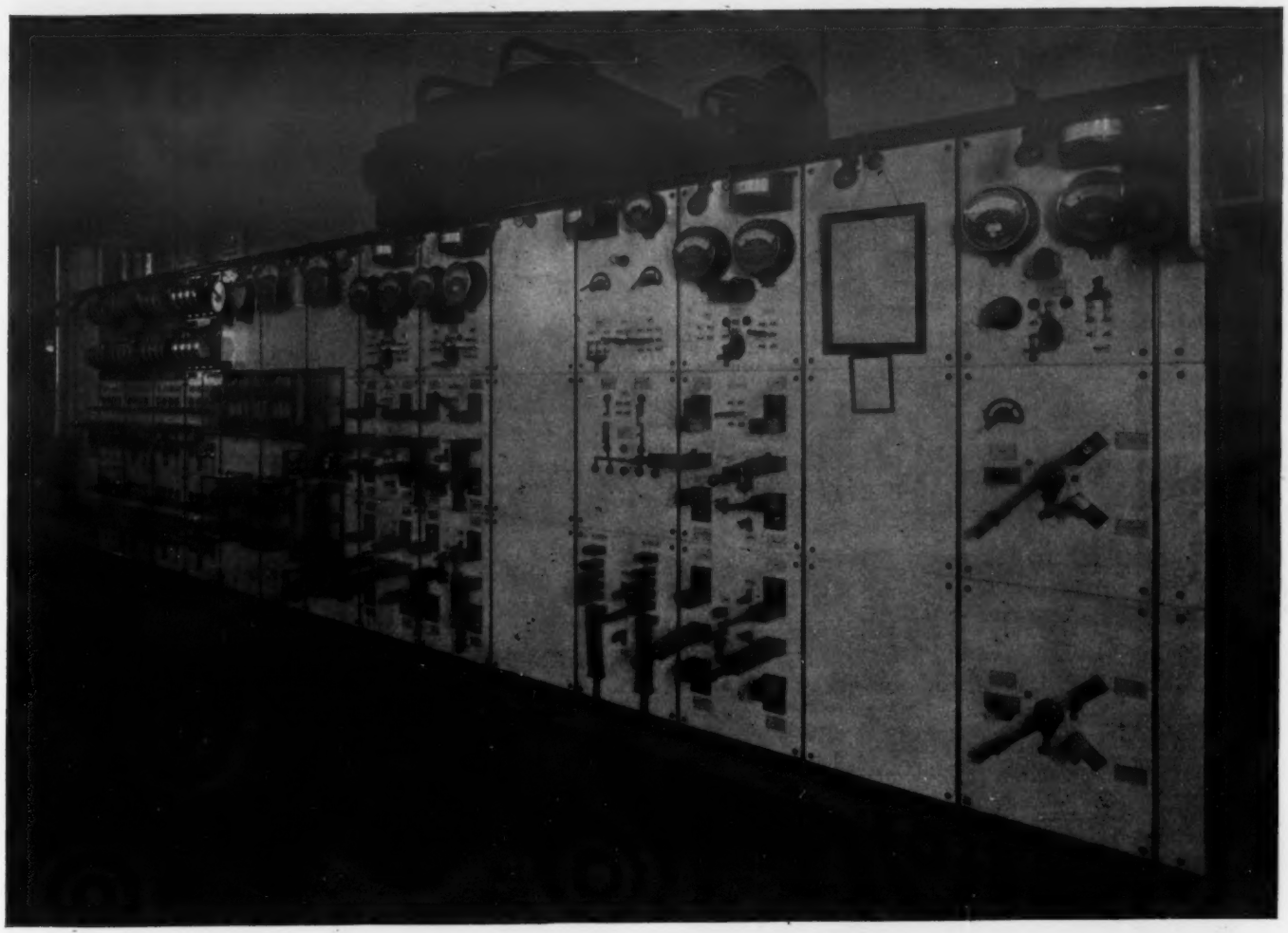


FIG. 4.—FRONT OF SWITCHBOARD OF LATEST DESIGN.

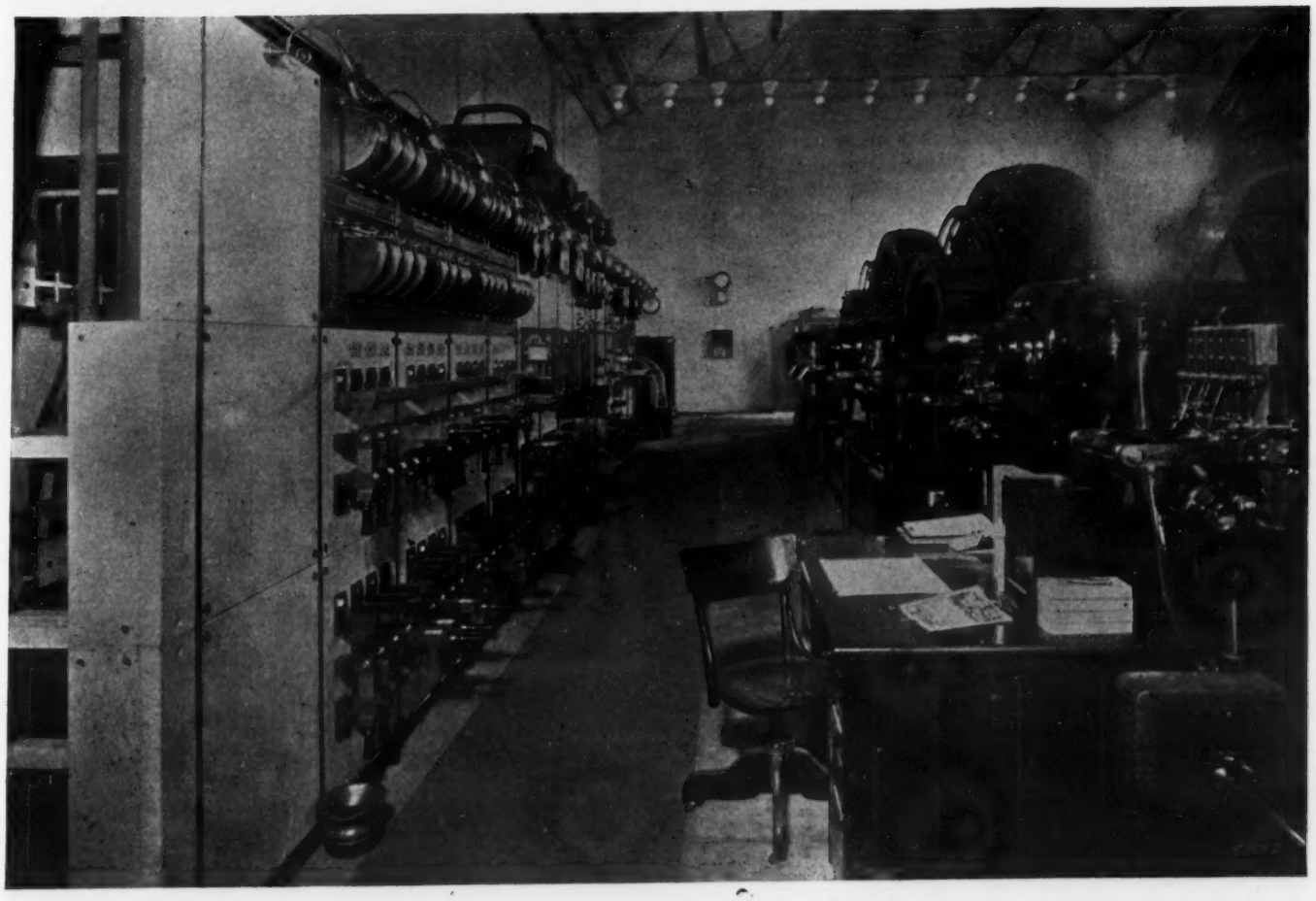


FIG. 5.—SUB-STATION AT WHITE CITY, CHICAGO.

tive auxiliary. The positive feeders are all brought out from the switch up and over to the wall, where, in this case, the fuse panel is located, while the negative leads are brought out from the switch down below the floor line and up to the negative fuse

FIG. 6.—SIDE VIEW OF FEEDER END OF BOARD.

panel. One-inch removable slate, which serves as the floor, protects this negative copper. The positive cables enter through the wall directly under the floor and are completely enclosed in tile up to a point near the fuse and a sufficient distance above negative cables to insure effective isolation. Similarly the negative cables are brought up in tile to a point near their terminals. The neutrals of the feeders terminate at the neutral bus located in the basement. This construction is believed to meet the requirements of the most exacting conditions.

Lighting Developments at Keene, N. H.

Recent developments in the electric lighting situation at Keene, N. H., may be regarded as fairly typical of the general trend of competition in the central station field in moderate-sized towns and even in large cities where for one reason or another a new supply company has been organized for the purpose of rectifying some real or fancied grievance, and to secure for the community an improvement in service or a lower cost.

The development of the electric lighting industry has been marked by numerous consolidations of electric with gas companies, particularly in small communities where the lighting business is not sufficient to warrant the independent operation of several corporations. And it is not infrequently the case that as a result of the combination the management deliberately fosters one branch of the business at the expense of the other, perhaps not openly, but often in such a manner as to warrant inferences and to cause extreme dissatisfaction among both old and new patrons.

Usually the establishment of a new competing company is adopted by the disaffected element as the most available means for accomplishing their ends whether it be in the direction of improved service or reduction in its cost. With the granting of the new franchises, a new schedule of rates is usually adopted, which will be sufficiently attractive to secure the necessary quota of lighting business. This in turn necessitates the selection of a generating and distribution system of such character that the production costs will be materially lower than those prevailing.

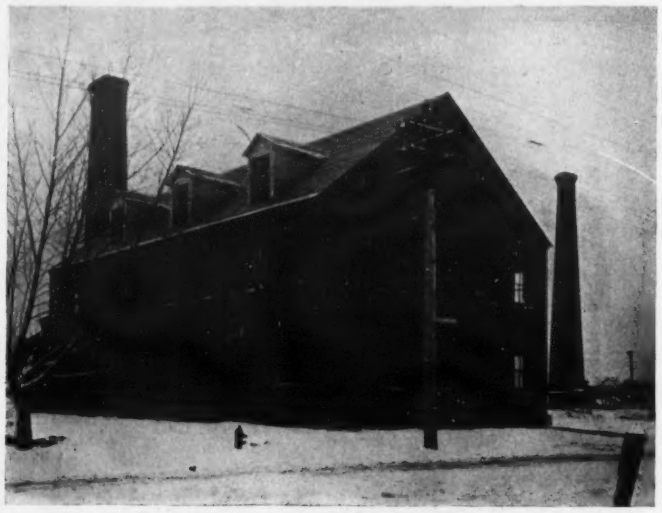


FIG. 1.—TERMINAL POLE NEAR POWER HOUSE.

This question finally narrows down to one of efficient power generation and in the end the type of motive power adopted is the criterion by which the success or failure of the undertaking may be judged.

In this respect it is a significant fact that the gas power system has recently been adopted in a number of cases for securing the end in view. Two prominent instances are those of the Citizens'

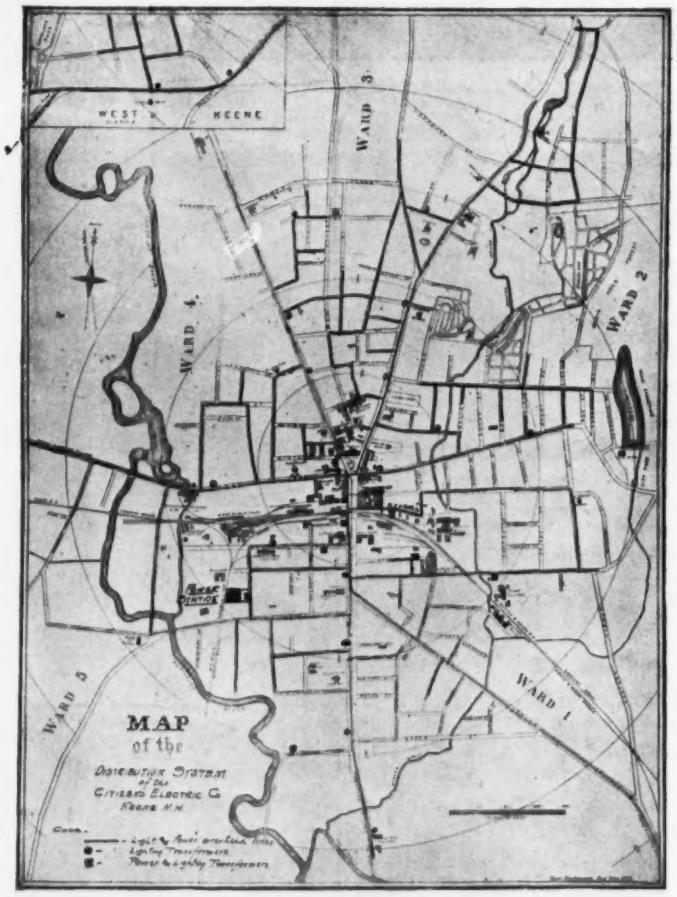


FIG. 2.—MAP OF DISTRIBUTION SYSTEM.

Electric Company, Keene, N. H., the system under description, and the Duquesne Lighting Company, of Pittsburg. In the case of the Duquesne Company the availability of natural gas greatly simplified the situation and practically insured low cost of production. In the case of the Keene system, however, producer gas was a necessity.

The situation at Keene developed early in 1905, through the action of a number of large property owners whose original idea was limited to "block lighting" in the business district. The possibility of street lighting, however, resulted in plans for

FIG. 3.—ONE OF TWO AUTOMATIC GAS PRODUCERS.

covering the entire city of Keene with a new up-to-date distribution system. It was charged that the established company had not only maintained exorbitant prices, but also had followed rather arbitrary methods in meeting new customers, especially where there was already a standing investment in gas mains in the particular territory.

A long step toward the accomplishment of the plans of the new company was made by a successful bid for the city lighting contract for a term of five years. Following this private lighting business was rapidly acquired and to-day the generating equipment originally installed is already nearing its capacity, so that the success of the undertaking is already reasonably assured. The new company endeavored to lease or acquire outright rights for stringing conductors on the old company's lines, but without success, and in the end an entirely new system had to be constructed from the power house to the customers' meters.

Construction work on this new system was brought to completion within a remarkably short time. The articles of incorporation of the Citizens' Electric Company were filed on the 5th of May, 1905; power station construction was commenced soon after, work was started on the distribution lines July 1, the public lighting contract was taken over November 1, 1905, and private lighting commenced on January 1, 1906. This in a period of four months from its inception the new lighting system was completed sufficiently for the commencement of regular service, and in six months entirely completed, both station and lines.

SERVICE RATES.

The service rates prevailing at Keene previous to the establishment of the new company were as follows: Lighting, 20 cents per kw-hour, with 20 per cent discount, if paid before the 10th of the month, or 16 cents net, with a minimum charge of $1.00 per month. There were no published rates for power, the rates varying according to the character of service rendered, from 10 cents down to 4½ cents per kw-hour, net, with a minimum charge of $1.00 per horse-power per month. For street lighting the old prices were about $100 per arc (6.6 amp.) for sundown to sunrise service, every night in the year, and $29 per lamp-year for series incandescents.

The rates established by the new company are based upon a sliding scale tending to encourage large customers. For private lighting a minimum of 75 cents per month was established, and a cash discount rate of 10 per cent on the following: For the first 25 kw-hours, 12 cents; for the next 25 kw-hours, 11 cents; for the next 25 kw-hours, 10 cents, and for the balance 8 cents, which is equivalent to a range from 10.8 per cent down to 7.2 per cent per kw-hour net. For power the rates are 5 cents down to 2½ cents per kw-hour net, with a minimum charge of 75 cents per horse-power per month. For city lighting the new company receives $82.50 per arc (6.9 amp.) for sundown to sunrise service, every night in the year, and $21 per lamp-year for series incandescents. Thus the Citizens' Electric Company has effected a reduction in the price of electricity to both municipal and private consumers of about one-third the former rates.

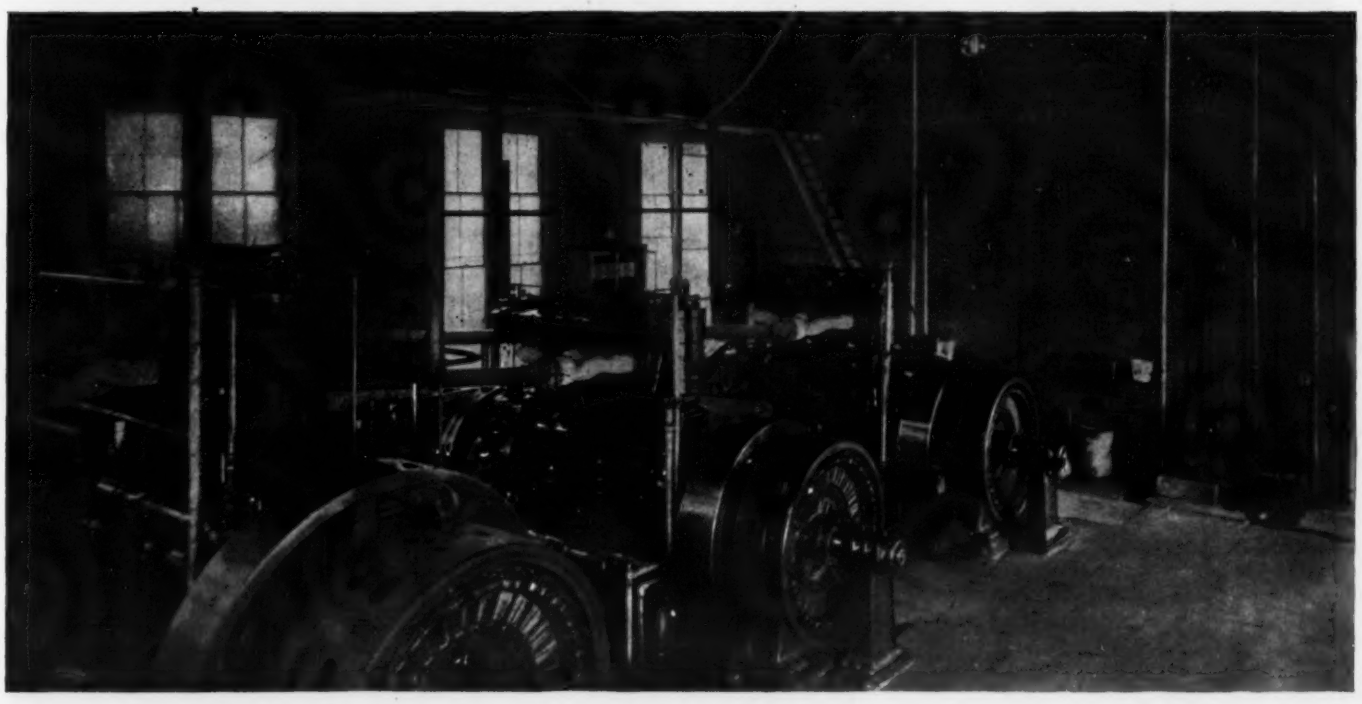


FIG. 4.—GENERAL VIEW OF DYNAMO ROOM.

SYSTEM.

The accompanying map (Fig. 2) shows the central territory covered by the distribution system of the Citizens' Electric Company and the location of the power house with relation to the business district, which is largely confined to the one-quarter mile circle around the central square. The center of load practically coincides with the geographical center of the city, which fact minimizes the copper required to handle the business load. Single-phase lines are used for arcs and three-phase for lighting. Grouped transformers are used entirely, located as shown on the map. A number of three-phase power circuits are run to supply factories located in various parts of the central district,

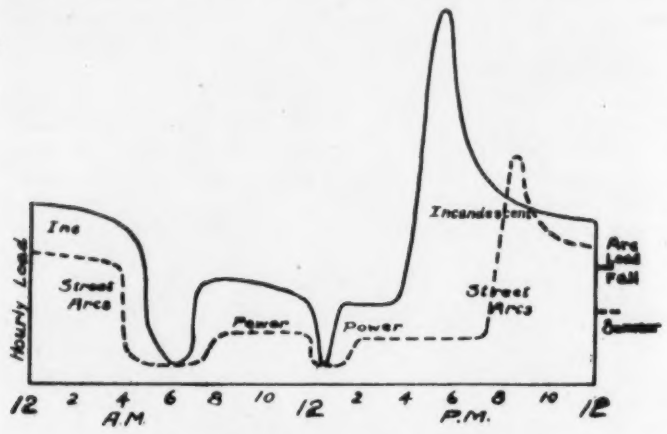


FIG. 5.—LOAD CURVE FOR 24 HOURS.

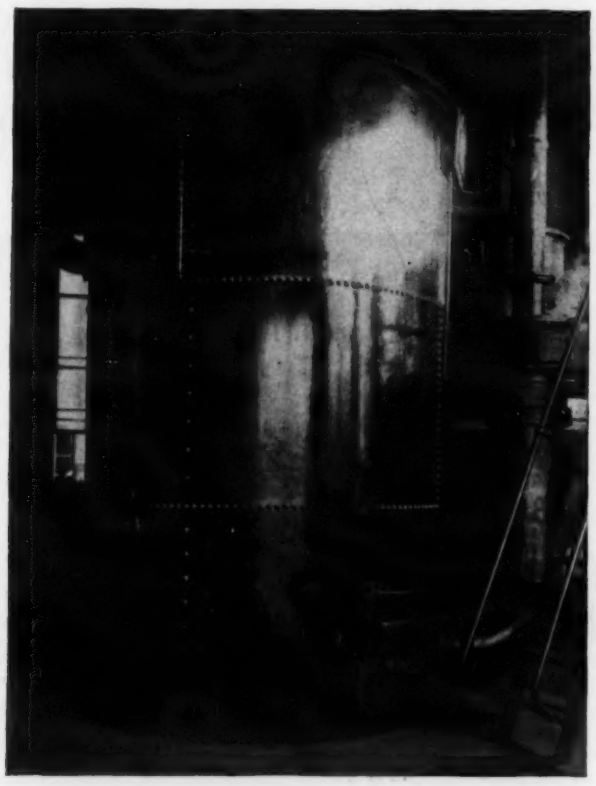


FIG. 6.—ONE OF THE SCRUBBERS.

but the entire system, including arc and incandescent lighting, is operated from the main power station bus, although an auxiliary bus is provided at the station for emergency use.

LOAD.

The load from this system is approximated in the accompanying load curves (Fig. 5), a comparison of which shows how rapidly the system is expanding. The station load factor for October, as represented by the curve, was 23.7 per cent. During the summer months, as indicated by the dotted curve, it was barely 15 per cent. The loading of the station is greatly assisted by the street arc load, which constitutes about one-half of the total load at peaks and continues through the night. During the day power load prevails, which disappears just in time for the evening peak. Thus the station is becoming fairly well situated as regards efficient handling of units.

ECONOMY.

Although complete returns are not yet available for the operation of the plant up to date, some data covering the summer months will be sufficient to show the general character of work that the station is capable of doing. The data of the accompanying table corresponds to the summer load curve. During a period of 2½ months the coal consumption at the producers averaged 2¼ lb. per kw-hour on a station loading factor of 14½ per cent, corresponding to less than half load continuously on the engines; referred to the engines this is equivalent to a coal consumption of 1.4 lb. per brake hp-hour under these extremely poor operating conditions. During this period anthracite pea coal averaging 12,350 B.t.u. was burned, and the heat efficiency from the plant from the coal pile to the engine shaft was 14¼ per cent, or from coal pile to bus-bar 12 per cent.

With increased load, such as represented by the load curve for October 9, the station was greatly improved in economy.

OPERATING LOG.

Date.	Average Daily Output K.W.H.	Engine Hours Average Run No. 1.	No. 2.	No. 3.	Coal Fired in Producers. Lbs. Per Day.	Lbs. Per K.W.H.	Lbs. Per BHP. Hr.
June—							
1-15....	944.5	8.46	9.0	6.74	2,147	2.27	1.44
15-30....	940.0	7.55	10.37	8.30	2,180	2.32	1.47
July—							
1-15....	882.7	8.82	9.65	6.82	1,914	2.17	1.37
15-31....	961.3	8.75	10.61	6.69	2,346	2.44	1.55
August—							
1-10....	965.0	8.70	10.00	5.70	2,120	2.20	1.39
Av. 71 days	938.7	8.4	9.93	6.85	2,141.4	2.28	1.44

Average Results.

Generating capacity of station = 270 Kw.	=	6,480 K.W.H. per day.
Average generating capacity in service = 92.8 Kw.	=	2,224.7 K.W.H. per day.
Station load factor	=	14.5%
Engine load factor	=	42.2%
Coal consumption plant (excl. boiler)	=	2.28 lbs. per K.W.H.
Coal consumption plant	=	1.445 lbs. per B.H.P. Hr.
Heat consumption plant (excl. boiler)	=	28,200 B.T.U./K.W.H.
Heat consumption plant	=	17,860 B.T.U./B.H.P. Hr.
Plant efficiency coal pile to engine shaft	=	14.25%
Plant efficiency coal pile to bus bar	=	12.1%

With a station loading factor of 23 per cent for the day, the fuel rate at the producers was 1.8 lb. per kw-hour, corresponding to a heat efficiency from coal pile to bus-bar of 15.4 per cent.

The cost of power is also low under the conditions. Considering the operating cost as including fuel, wages, general supplies and running repairs, the total cost during the summer months was 1.7 cent per kw-hour on an average output of only about one-seventh of the plant capacity. At the present rate of increase in economy with loading the cost will approximate 1 cent per kw-hour at one-fourth station load, and a cost of .75 cents per kw-hour is well within the possibilities of the plant when the system is fully developed. Even assuming that the management and capital charges upon the system will double the station operating costs the reason is obvious for offering such low service rates as prevail. Day power load will be particularly effective in reducing the general costs and in enabling the plant equipment to work at its highest efficiency.

POWER STATION.

The power station is a plain brick rectangular structure with a coal bin in the rear extending to the railroad siding. An illustration of the difference in the character of steam and gas equipments is offered by the fact that the producer room occupies but one-third of the building, the remainder being devoted to generator machinery; also that the coal bin, although of moderate dimensions, contains sufficient fuel to run the plant for six months at the average rate of output. The building has no chimney, those shown in the view belonging to neighboring factories.

A rather conventional arrangement of engines is shown in Fig. 4. The equipment is of the familiar Westinghouse three-cylinder, vertical, single-acting type, aggregating 400 hp, and operating direct-connected, three-phase alternators in parallel

upon a common bus-bar. The electrical plant is handled in precisely the same manner as the ordinary steam equipment. The engines are started by compressed air kept in storage tanks at 150 lb. pressure, which are refilled by a motor-driven compressor shown in the background. This, however, is relayed by a small gas-driven compressor. A motor-driven pump is also shown in the background, which supplies cooling water to an elevated tank from which it flows directly to the engine jackets under a small static head. The entire pumping arrangement is automatic and maintains a constant level in the tank.

Four independent sources of ignition current are available in case of necessity, viz.: primary batteries, storage batteries, individual belt-driven exciters, and a 1-kw motor-driven generator set which is normally used for this purpose.

GAS PRODUCER PLANT.

This part of the station consists of two 250-hp producer sets of the Westinghouse automatic water-sealed type; one of these is shown in the accompanying Fig. 3. Coal falls to the producer hopper from a small bunker above, which is fed by a motor-driven bucket elevator. Ashes are removed from the water seal beneath. Several poke holes at the top provide a means for loosening the fires, which is done but once or twice in a shift of 12 hours. Hot gas leaving the producer passes into the base of a scrubber (Fig. 6), ascends through a coke section wetted down by water sprays, returns to the bottom of the scrubber and ascends again through an excelsior section which dries the gas ready for engine consumption. A small steam boiler, not shown, supplies an ejector blower by which the blast to the producer is maintained at the proper rate and with the proper proportion of air and steam.

It is an important feature of this system that no holder is necessary, and the equipment as shown is complete. The rate of gassification is controlled automatically by a simple regulator which proportions the blast to the demand for gas from the engines. This regulator is so sensitive that it follows instantly any change in pressure at the outlet of the scrubber and requires no continual hand adjustment.

The operation of the producer plant is extremely simple. Coal is handled by mechanical means from the time it is unloaded until 15 per cent of it is removed in the form of ash from the pits once in 24 hours. As each producer hopper holds about 275 lb. and the plant consumes coal at an average rate of 117 lb. per hour, it is evident that the charging requires little attention. Fires operate best when left to themselves, with the exception of an occasional loosening up along the walls. In the scrubbers the coke is indestructible, and the excelsior section, with anthracite gas, requires renewal barely twice a year. Two men operate this entire plant, and were it not for consideration of mutual safety, one man could tend to the entire equipment, and has done so in case of emergency, getting a new unit in service in less than a minute without assistance, the producer meanwhile taking care of itself automatically.

To a practical man the simplification not only of equipment, but also of the operation of a central station may be regarded in one sense as the highest development of the art. The producer system would seem to have accomplished much in this direction, and that the Keene plant has been operated with continued success, and by operatives at first entirely unfamiliar with the new system, is a good indication that the system is practical and constitutes an important factor in central station development for the immediate future.

Zinc Oxide as an Insulator.

A patent issued November 13 to Mr. George Kelly discloses the fact that the discarded woven-fabric chutes used for conveying condensed zinc oxide can be made into an insulating material when mixed with other ingredients. The discarded fabric is cut into sheets of the desired size and moistened by brushing with or dipping into a liquid vulcanizing and binding composition composed of rubber, sulphur and liquid glass (silicate of sodium). The resultant product is stated to be a high-grade electric insulating board, slab, plate, or the like that is thoroughly homogeneous.

The Purification of Lubricating Oil.

By JAMES L. GRANT.

Some time ago a manufacturer asked me what kind of oil I used for lubricating my engine, and in reply I gave him the brand and stated who sold it. I also stated that the price is 50 cents per gallon. His further remarks were to the effect that inasmuch as my plant was owned by the city such extravagance could be afforded, but that men who were in business for the purpose of making a living must buy cheaper oils.

The injustice in this view of the case is so manifest that an explanation of it cannot fail to be of interest and value to thousands of steam users, who believe in this theory, and continue the same practice although they are making a great mistake in so doing, as it is neither economical nor wise on other accounts. This man pays about 20 cents per gallon at retail for an inferior oil, uses it once and allows it to waste, therefore his lubrication (such as he gets), costs him 20 cents per gallon.

About 10 per cent of my oil goes to waste after being used once, making the cost of this lubrication, which is first class in every respect, 5 cents per gallon. It is probably well within the limit to say that I filter the remaining 90 per cent 20 times

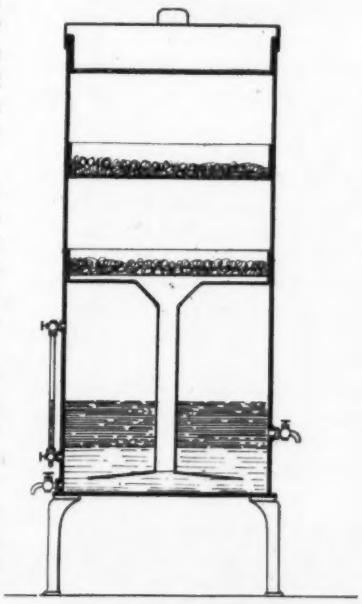


FIG. 1.—OIL EILTER.

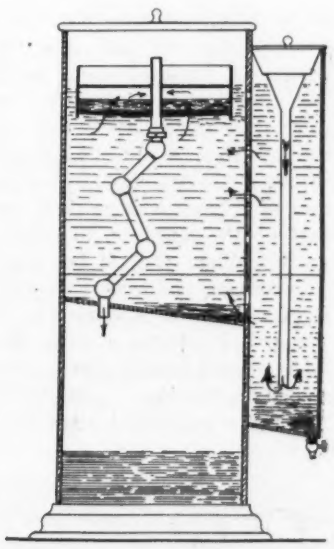


FIG. 2.—OIL FILTER.

over, making the cost of lubrication with filtered oil 2¼ cents per gallon, or an average of less than 2½ cents on the above basis. While this is only an estimate, it is approximately correct, and basing a conclusion on these facts it appears that the manufacturer who is working hard to make a living, spends more for lubricating his engines than is paid for better lubrication in the municipal plant.

Furthermore the new oil and the filtered oil are carefully kept separate in order to know the quality of work done by the filter, and a stranger could not tell the difference by comparing them in glass oilers.

This filter is illustrated in Fig. 1. Unclean oil is poured into the top pan the bottom of which consists of a fine brass strainer. This catches the coarser impurities, such as pieces of waste, etc., while finer foreign matter passes down to the next pan, which is partly filled with cotton, resting on cotton cloth supported by a fine mesh screen bottom. The third pan is similar to this, and after passing it the oil goes down into water, and as it must go below the surface it quickly rises and is washed in the process, thus removing impurities that may have passed the filtering material.

Some of the oil caught from the bearings of engines is mixed with water, and as this is heavier than oil it settles to the bottom, but care should be taken to prevent it from accumulating until it reaches the upper faucet, where it can be drawn out with the oil forming a mixture that will neither work well in

sight feed oil cups, nor lubricate bearings properly. Another faucet located lower down is provided for drawing off some of this water when there is a surplus of it. A gauge glass is used to indicate the amount of oil and water in the body of the filter.

Fig. 2 works on a somewhat different principle, as the oil to be cleansed is poured into the funnel at the right hand, passes

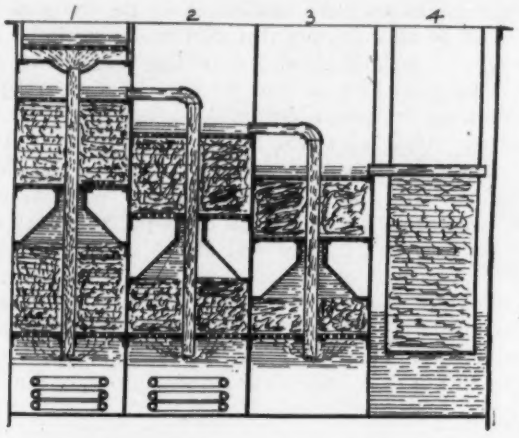


FIG. 3.—SECTIONAL OIL FILTER.

down through a tube that delivers it nearly to the bottom of a water chamber, and when liberated from this tube it quickly passes up through water and is washed in the process.

It then passes to the left hand into the large shell, the upper part of which is fitted with filtering material, therefore when the oil rises because its specific gravity is less, it is forced through this material, hence all impurities are left on the bottom of it from whence they may fall to the bottom of the upper half of the tank, as an inclined partition divides it into two parts. When the oil has risen high enough it falls into the jointed pipe and goes to the reservoir in the lower part of the shell, whence it is drawn at pleasure.

Fig. 3 illustrates a more elaborate filter into which unclean oil is poured into section 1 and passes down through the vertical tube into the lower part, which contains water. It then rises through a perforated plate and filtering material above it, until

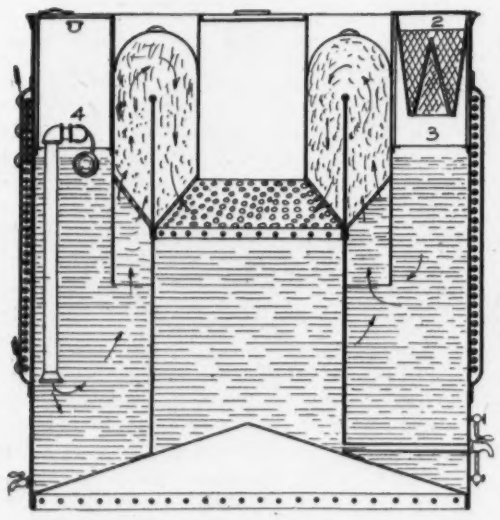


FIG. 4.—FILTER, WITH LARGE SETTLING CHAMBER.

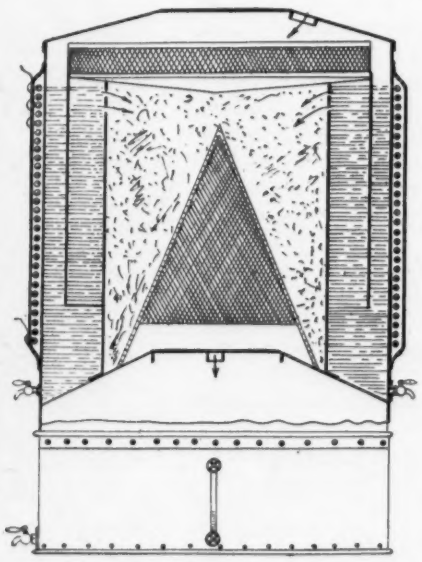


FIG. 5.—FILTER, WITH ELECTRIC JACKET.

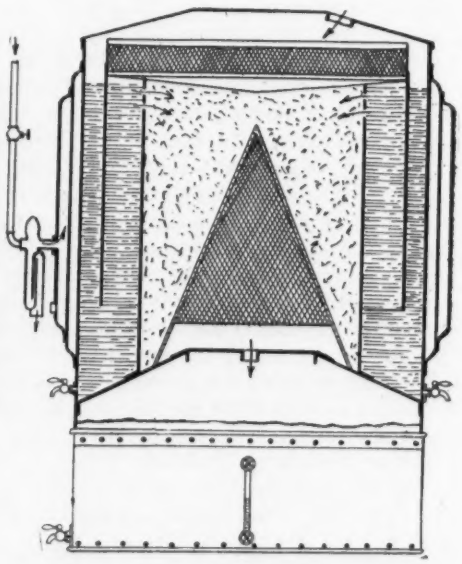


FIG. 6.—FILTER, WITH STEAM JACKET.

the cone is reached, which directs it towards the center of the chamber, which retains some of the impurities

It then passes on through another layer of filtering material until it reaches the overflow pipe that conducts it to the bottom of section 2 and from thence into section 3, in both of which the cleansing process is repeated. On reaching section 4 it passes into the horizontal perforated pipe and, going downward through more filtering material, finally reaches the pure oil reservoir from which it may be drawn for use. Steam pipes are shown in the lower part of sections 1 and 2, and steam enough should circulate through them to keep the temperature of the filter at about 100° F., as the heat will assist the process of cleansing heavy oil. A thermometer is provided for the purpose of indicating the temperature and enabling the engineer to regulate it.

It is surprising to note the indifference displayed by some steam users concerning waste of oil in their plants, as illustrated by the following incident in my own experience: A friend who is in charge of an engine that requires a large quantity of oil to keep its bearings cool, reported that none of this oil was saved and used over again, as it was customary to use it once and then throw it on the coal heap. I investigated the case and informed the superintendent that I would put a good oil filter into his engine room, and if he would pay me one-half of the value of what oil it saved during six months' time, I would give him a receipted bill for the same, thus giving him the other half saved, and all that it was sure to save afterwards. He was to report the amount, and I was to accept his report as final, but he would not accept the proposition, although no restriction whatever was to be laid on the quantity of oil used during the test. The last time that I heard from the place oil was going to waste the same as before the proposition was submitted.

Fig. 4 illustrates a filter that is fitted with a very large settling chamber. Dirty oil is poured into the removable strainer 2 that retains the coarse impurities, and from there it falls into the dirty oil storage chamber 3. It is admitted to the refining chamber through the float valve 4 as fast as there is room for it in this department. Arrows show the action of oil as it is drawn upward, and then creeps downward over the dividing partition, and here is where the most important cleansing process takes place as it is due to capillary attraction which takes oil only, leaving all impurities behind. The filtering material through which capillary action takes place in this filter, is best white waste. Oil is delivered into the central chamber where it is stored for use. Suitable drain cocks are provided to draw off impurities.

It is generally admitted that, more or less heat is required to enable a filter to give best results, but opinions differ as to how and where the heat should be applied. In this case it is applied by means of copper wires encircling the filter, through which an electric current is passed and the heat thus radiated is sufficient to greatly facilitate the cleansing process. These wires are enclosed as shown to prevent loss of heat, hence the design is known as the electric jacket.

Fig. 5 is another filter in which the electric jacket is used to secure the desired temperature. In all such cases the wiring is adapted to the kind and strength of current available, and directions are given for properly connecting them, after which no further attention is required.

Dirty oil is poured into the upper compartment of this filter out of which it passes through fine mesh straining surface set in a vertical position. It is claimed that this is less liable to become clogged from long use, than if the strainer was set horizontally. The oil passes to the settling chamber below the strainer, travels downward to the bottom of the deflecting shield shown, turns and travels upward inside of it and then enters the filtering chamber where it goes through a body of compact white waste. It is then ready for use again.

Fig. 6 is practically the same as the preceding except that steam is used to heat the jacket instead of electricity.

The first attempt that I ever saw made to purify oil and use it over again was in an electric station where Armington & Simms engines were run at what was then considered a very high rate of speed, probably 275 revolutions per minute. Oil was used freely, as it was considered absolutely necessary, but no provision had been made for purifying it. The amount used was excessive, and to reduce it somewhat the engineer spread a piece of cotton cloth over his oil tank, depressed it in the center and poured the impure oil into it. This acted as a very fine strainer and saved many gallons of oil, but it was not a filter. At that time there were few filters in use, but the extended use of high-speed engines made them popular.

In a subsequent issue illustrated descriptions of other types of oil filters will be published.

Cutting Steel Piles by Means of the Electric Arc.

In the November 3 issue mention was made of the fact that in the construction of the new Hoffman House at Broadway and Twenty-fifth Street, New York City, electricity is used to cut the heavy interlocking steel piling used in the foundation work, and which owing to the unevenness of the underlying rock projected unevenly above the proper level. We are now enabled to give some further information on this interesting application of electricity together with the cost of operation.

Unfortunately, direct current could not be used in the process without throwing the Edison three-wire system out of balance, as it would be necessary to use the Edison service, which has a grounded neutral, or else install an isolated plant, which was out of the question. Four 20-kw transformers are connected in multiple to the lines of the United Electric Light & Power Company, which are single-phase, and have a potential of 2,500 volts. The secondary voltage is 50. Experiments were made with current at a potential of 105 volts, and again with current at a potential of 25 volts, but both potentials proved unsatisfactory so that the original potential, 50 volts, was retained. One wire of the circuit is bolted to the sheet piling and the other is connected directly with the carbon electrode. The latter is 1¼ in. by ¾ in. long and is clamped between two plates of copper 5 in. square by ½ in. thick. A Dossert lug is used to make the connection, as a sweated joint is out of the question because of the intense heat. As it is the copper plates buckle after 15 hours' use and new ones must be provided.

The workmen wear masks of asbestos and gloves of the same material to protect them from the heat. The mask is provided with double black glass, which will permit the operator just to see the arc. This protection is put aside at all times when the arc is not in use, but during the cutting process the arrangement permits the arc to be carefully scrutinized without any injury to the eyes or skin. When first tried no protection was thought advisable; but it was found that even at a distance of 11 ft. from the arc the carbon dust and fumes festered the lips of the operator, and at night the pain in the eyes was intense. The arc produced an excessive flow of water from the eyes and it appeared to the operator as though a film were thrown over them. The heat also blistered the skin.

FIG. 2.—SHOWING SUPPORT FOR ELECTRODE AND CHARACTER OF PILING.

The arrangement of the cutting electrode is clearly shown in the engraving as well as the protection worn by the operator when at work. The circuit is completed without extra resistance; the operator merely pushing the carbon electrodes against the iron, thus forming the arc. Once started care is exercised by the operator that the arc is not disrupted. The depth of the cut varies from ½ in. in the center of the pile to 3½ in. at the junction and the character of the cut is well shown in the engravings. Tests show that 650 amp. is consumed at the arc, and at a potential of 50 volts this is equivalent to a consumption of 32 kw. In a day of eight hours it has been found that with the device 10 ft. of piling can be cut through with an energy consumption of 256 kw-hours. The wage of the attendant is $4.00 per day, and even with energy at 10 cents per kw-hour the total

FIG. 1.—SHOWING OPERATOR AND ELECTRODE.

FIG. 3.—ELECTRIC STEEL PILE CUTTER IN OPERATION.

cost of operation is in round numbers $30 per day, or $3.00 per foot of piling cut. It has been found that with the use of electric drills two men were required to cut through a foot of piling in a day. The wages of these two men was $9.00 and the energy consumption of the drills was 44 kw-hours. With energy at the same rate this would cost at the rate of $13.40 per foot of

FIG. 4.—SHOWING CHARACTER OF CUT MADE BY ELECTRODE.

piling cut. Neglecting entirely the question of dispatch, which is all-important in New York building operations, the arc cutting device shows a saving of over $10.00 per foot. The actual saving is somewhat more than this, since with the energy consumption of the arc cutting device and considering that it is a day load, the rate would be less than 10 cents per kw-hour.

Burning Soft Coal.

By William D. Ennis.

The use of soft coal as fuel for steam boilers is increasing. Originating as a matter of necessity, its continuance has been due to a variety of causes. Firemen find that soft coal makes a "live" fire. Owners of plants find it cheaper per ton than any but the finer sizes of anthracite. In plants having insufficient boiler capacity, operation is practicable on soft coal when the use of any hard coal smaller than pea size would be impossible. The soft coal can be burned with less draft and with less grate surface, and even the fine broken "slack" is preferred to fine sizes of anthracite. Whether this will continue permanently to be the case is doubtful. Rearrangement of grate and draft conditions to permit of the use of anthracite rice and barley coal seems inevitable in view of the fact that at present New York prices the run-of-mine soft coal is about 30 per cent more costly than No. 2 buckwheat when both are valued on the basis of heating value.

For the present, at least, and probably for some time to come, attention must be given to economical methods of burning soft coal. It should be remembered that aside from ordinary principles of good management little can be suggested to the power plant operator that will enable him to improve the efficiencies of his engine-room apparatus. The economical performance of engine, generator and auxiliaries is almost wholly a matter of design. It is doubtful whether (excepting in a case of hadly "run down" equipment) the efficiencies of this portion of the plant can be increased even so much as ten per cent.

The moment the fire-room door is passed, an entirely different condition of things is found. Between common, disinterested shoveling and the best possible skilled and careful firing, there is a difference of not less than 100 per cent. So wide a difference is particularly apt to be noted in comparing plants where soft coal is used. The fire-room, therefore, comes very near to being the whole plant, so far as operating mechanical economy is concerned; and as will be shown later, one apparently insignificant factor comes very near to being the whole story in the fire-room.

In the first place, what is soft coal? It is known that all coal consists essentially of carbon, mingled with more or less incombustible ash and with some moisture. In fact, these three constituents are practically all that are contained in hard coal or anthracite. In soft coal, however, in addition to the solid carbon—which combines with the oxygen of the air to form carbon dioxide gas—there is a varying percentage of "hydro-carbons." These are compounds of carbon and hydrogen in various proportions, which are driven off from the body of the coal at a comparatively low temperature, usually in the form of black smoke. These gaseous bodies, if sufficiently heated, unite with the oxygen of the air, as does the carbon, producing carbon dioxide, water, etc.; and in so combining with oxygen, produce heat.

A coal is known as "hard," or anthracite, when the "fixed" or non-gaseous carbon is from 92.3 per cent upward of the total weight of combustible in the fuel. Thus, if coal on analysis shows 80 per cent fixed carbon, 5 per cent hydro-carbon, 7 per cent ash, 8 per cent moisture, then the combustible part of the coal is 85 per cent of the total, and the fixed carbon being $80 \div .85 = 94$ per cent of the combustible, the coal is anthracite. Coal in which the fixed carbon constitutes from 87.5 to 92.3 per cent of the total combustible is semi-anthracite. Semi-bituminous coal has a fixed carbon ratio of from 75 to 87.5 per cent; true bituminous coals have a ratio below 75 per cent. It is worthy of note, therefore, that soft coal differs from hard in containing less fixed carbon, and more hydrocarbon or volatile matter. One might go on with this classification, assigning to lignite a still lower carbon ratio than to soft coal, finally reaching wood, having the lowest carbon ratio of all.

It is this high percentage of volatile hydrocarbon that causes most of the difficulties in burning soft coal. When a few shovels of such coal are thrown on an ordinary fire, the heat causes the hydrocarbons to gasify and pass off immediately in large quantities. But the heat is not sufficient to burn these gases; they escape either as visible smoke or as invisible gas, without having produced the useful heating effect which should be produced. Even if there is sufficient heat—as there is apt to be if only a slight amount of coal at a time is fired—these gases may still escape unburned, because of lack of air to supply the oxygen for combustion. For this reason, firemen sometimes open the door for a moment after shoveling on fresh coal. The objection to this is, that the cold air tends to chill the fire. Very often, too, the fireman does not close the door as soon as he should.

What method should one adopt, then, to get all of the heat out of these volatile hydrocarbons? Observe, first, that a smokeless chimney does not mean, necessarily, good combustion. In fact, under certain circumstances, a slight amount of smoke may indicate economical firing. This smoke matter, from a standpoint of economy, has been altogether over-rated. One observer found that perceptibly black smoke contained 2 grains of carbon per cubic foot. This is worth saving, of course; in fact, must be saved; but the losses which we are now trying to get after are many times this.

As has been pointed out, practically all of the fuel should eventually be burned to carbon dioxide gas (CO_2). It will be, if a sufficient quantity of oxygen is supplied, at a rather high temperature, so that the gases will not be chilled below the combining temperature. In uniting with oxygen to form CO_2, one pound of carbon evolves 14,500 units of heat. If the supply of oxygen is limited, the carbon will unite as best it can with this limited supply, forming another gas, CO, which contains a lower relative proportion of oxygen. But in uniting (or burning) to form CO, one pound of carbon generates only 4,400 units of heat; only 30 per cent of the heat evolved when an abundance of oxygen is supplied.

The same condition holds true of the volatile hydrocarbons; given a sufficient supply of oxygen, the heat generated is greatly in excess of that obtainable when the supply is restricted. One pound of carbon requires, in order that CO_2 may be formed, about $2\frac{2}{3}$ lbs. of oxygen; and as air contains 23 per cent of oxygen by weight, the amount of air to be supplied per pound of carbon is $2\frac{2}{3} \div .23 = 11.6$ lbs. If one should calculate in a similar way, the amount of air necessary for the hydrocarbons, it would seem that so long as the total computed weight of air for each pound of coal burned were supplied, one would be sure to have perfect combustion. As a matter of fact, it is found that the carbon and the hydrocarbons do not combine with the oxy-

gen as thoroughly and as quickly as would be desirable, and consequently some surplus oxygen must always be supplied when the flue gases are analyzed. Consequently, the result may show no CO, some CO_2 and some oxygen.

The unfortunate feature of the presence of this oxygen is that it represents more than four times its weight of air, which, entering under the grate at the temperature of the room, has been wastefully heated up to 500 or 600°, the temperature at which it leaves the boiler. An endeavor should, therefore, be made to reduce this excess of air and consequent percentage of oxygen in the flue gases, to as low a figure as possible. With careless operation, the excess may be as much as 200 or 300 per cent of the amount actually required for combustion, while under the best control the excess is sometimes reduced as low as 30 or 40 per cent, without any appearance of CO in place of CO_2.

In order to ascertain, for any particular boiler, just what excess of air is being wastefully heated, it is only necessary to make a simple chemical analysis of the flue gases. Any chemical supply house can furnish an Orsat gas apparatus, and any person of average intelligence can learn to manipulate the apparatus in a short time. By its aid the percentage of oxygen, CO and CO_2 in the flue gas may be found. The CO_2 should first be determined. If from 12 to 14 per cent is found under average conditions, nothing better can be expected. There are probably not a dozen power plants in the country obtaining such percentages, although if the excess air were entirely done away with, the percentage of CO_2 would be much higher than this. The percentage of CO_2 being found to be low, the next step is to determine the CO. In ninety-nine cases out of a hundred no CO will be found. If it should be found, then the air supply is insufficient and should be gradually increased.

Assuming that no CO is found, the gas should next be treated for oxygen, find its presence in amounts corresponding to the percentage of excess air, and note that as the amount of oxygen decreases the percentage of CO_2 increases, and vice versa. The whole aim now is to increase the percentage of CO_2. When it is at the highest possible point, there will be a total absence of CO and only a small quantity of oxygen. If the air supply is varied ever so little—even so much as would be caused by the cracking of a clinker—CO will appear, or oxygen percentage will increase, the CO_2 in either case decreasing. So all-important is this question that machines have been devised to automatically determine the amount of CO_2 in flue gases, on the assumption—a correct assumption—that a knowledge of this result is all the fireman needs in order to know whether or not he is firing properly.

Making the production of maximum CO_2 the object, there are just three points to observe: 1. The hydrocarbons should be supplied with air when they need it. 2. The air (or oxygen) should be hot when it reaches them. 3. The amount of air supplied should be so regulated as to produce the highest possible percentage of CO_2. The matter of air supply is therefore very nearly all there is to consider in the fireroom.

As to the first point, the air is needed by the hydrocarbons from the moment when they begin to burst out of the green coal as dense, greenish-black, bad-smelling smoke. It is needed for a sufficient length of time to enable all of this black smoke and all of the invisible gas to be completely burned to CO_2 in long, dazzling white flames. For this reason there must be plenty of room over the grate for these flames, and if possible they should travel some distance before they strike the comparatively cold boiler, giving them time to unite with the oxygen. These requirements cannot be ignored if good combustion is to result.

As to heating the oxygen: The best way of doing this is to have one part of the fire always red hot, by firing coal alternately on opposite sides of the grate. There are practical difficulties in doing this, sometimes, and when the coal contains more than a moderate amount of hydrocarbon the easiest way of accomplishing the result is by using stokers, which provide a constantly smoking bed of green fuel at one end of the grate, from which the hydrocarbons pass over the red hot fire covering the entire grate and mingle with air which has passed through this fire. In this way the hydrocarbons reach nothing but heated air (unless there are leaks through the brickwork). If cold air is supplied perfect combustion will not result.

Regarding quantity of air supply: The proper quantity may be exceeded by reason of leaks in the setting or because of excessive draft. Leaks in the setting can be overcome without the exercise of skilled firing; so also, it might be thought, could excessive draft. But after eliminating everything else, the fact remains that the vast majority of our soft coal burning plants are wasting from one-fourth to one-half of the fuel for the simple reason that the operators do not pay sufficient attention to the position of dampers and ash pit doors.

Excessive air may also be used because of holes in the fire, cracked clinkers, bad spreading, etc. These are all practical firing matters and to name them suggests the remedy. No fireman who is not already disposed to work to advantage in these respects can be expected to take much interest in the question of draft control.

In this small matter of the position of the damper lies the greatest possibility of economy in the modern power plant. No other controllable or uncontrollable factor excepting the rejection of heat from engine to condenser can compare with it in magnitude.

Boiler Feeding.

By R. T. Strohm.

THERE are three methods of introducing feed water into steam boilers. The one most commonly used, in stationary practice at least, is by pump. Another common means of feeding the boiler is by the injector. The third method, which is less frequently used than either of the foregoing, employs the force of gravity only.

When a pump is used to supply water to a boiler it may be driven in any one of three ways. Ordinarily, it is a direct-acting steam-driven pump, either single or duplex. However, it may be driven by belt from the main shaft of one of the engines; and in exceptional cases, the feed pump may be driven by its own individual electric motor.

Much has been said regarding the relative merits of the power-driven pump and the direct-acting steam pump. Considered merely as an apparatus for transforming the heat energy of steam into work, the ordinary steam pump is about the most inefficient contrivance that could be secured. It uses steam full stroke, thereby gaining no advantage whatever from expansion. As a consequence, the steam consumption of the common boiler feed pump may easily run as high as 150 or 200 pounds of steam per horse-power per hour. The steam engine, on the other hand, working with considerable ratios of expansion, may produce one horse-power per hour on a steam consumption of from 15 to 20 pounds, or just one-tenth that of the pump.

Basing judgment merely upon the relative performances of the engine and the pump, it is plain that the power-driven pump, connected to the main engine, would be able to give much more efficient service than the steam-driven pump, while even the electrically-operated pump could show better results than the steam-driven, after allowing for electrical and mechanical losses. Notwithstanding these facts, the direct-acting steam pump is more largely used than any other means for feeding stationary steam boilers. This being true, there must be something more than a mere question of steam consumption involved in the matter.

Such, indeed, proves to be the case. For, in spite of the fact that the steam pump converts but a very small percentage of the heat of the steam into work, the heat voided in the exhaust is not lost, since it is passed through a feed-water heater, by which means the heat that would otherwise go to waste is returned to the boiler from which it was derived. As a result the actual amount of heat charged up to the direct-acting steam pump for the purpose of forcing the feed-water into the boiler becomes comparatively small.

In the case of the steam engine, the steam is used quite efficiently, but that which is exhausted into the condenser gives up its heat to the condensing water, so that a large portion of the heat is thrown away. Consequently, the power-driven pump, operated by highly efficient engines, has been unable to show any great advantage in economy over the ordinary type of feed pump.

It must not be inferred, however, that any number of auxiliary pumps may be used without affecting the economy of operation.

This practice should be carried no further than the point where the exhaust may all be utilized. If the steam that is exhausted from the pumps in a plant exceeds in amount that required to heat the feed-water properly, so that some of it must go to waste, then the economy of the plant is being sacrificed. But so long as all the heat in the exhaust can be used for feed-water heating, the high rate of steam consumption of a pump need not be considered.

Even though the amount of steam demanded from the boilers is greatly increased by the use of direct-acting feed pumps, it must be borne in mind that the temperature of the feed water returned from the heater will be greatly in excess of that which would be obtained in case highly efficient engines were used to drive the pumps. As a consequence, less heat will be required to convert this feed water into steam at the working pressure, which means that the coal consumption per unit of water evaporated will be lessened. In other words, the use of more steam, in conjunction with an exhaust heater, enables the boiler to produce more steam, with an increase in the ultimate economy of working.

The power required to force a definite quantity of water into a boiler at a given pressure is constant, no matter whether the work is done by a steam pump or a power pump, and, as already shown, the steam pump effects this result quite as well as the power-driven pump. If there is ample exhaust for heating without including feed-pump exhaust, then it will be found economical to use feed pumps driven either by motors or direct from the main engines.

The direct-acting steam pump possesses a number of distinct advantages as a device for boiler feeding. Its speed, and consequently the rate of discharge, may be varied to suit the rapidity of evaporation by simply manipulating the valve in the discharge pipe. In the case of the power pump, the speed remains constant, and if the rate of evaporation decreases, some of the water must be sent to an overflow, or the suction must be throttled somewhat. Of course, it would be possible to fill the boiler to the desired level, and then stop the pump until the evaporation had carried the level to a point where more water was required. However, this would mean intermittent feeding, with considerable fluctuation of the water level, and such action is not desirable.

The most efficient device for boiler feeding is the injector, since it takes up cold feed water, heats it, and delivers it to the boiler in a uniform stream and at a high temperature, with no loss of heat except the very small amount radiated from the instrument. Owing to the high velocity with which the water issues from the injector, the size required to feed a boiler of large capacity is comparatively small, and consequently the injector occupies but small space. All the heat in the steam, except that which is transformed into work, is given up to the feed water, and thus returned to the boiler. Furthermore, the injector is a simple device, easy to operate, and of so few moving parts that wear is slow and repairs infrequent.

Some engineers, however, find that the use of the injector for boiler feeding has a bad effect upon the steam pressure in the boiler. They say that while the injector is working, the steam pressure steadily falls, and that this decrease of pressure may seriously interfere with the operation of the plant, especially where a single boiler is used. The reason for this may lie in the use of too large an injector, but it is probably accounted for by the fact that the injector is not merely a force pump, but a heater as well, and therefore it requires considerable steam to accomplish both purposes at the same time. By throttling the feed, the injector may be made to deliver a small quantity of water to the boiler in a given time, but to deliver it at a higher temperature.

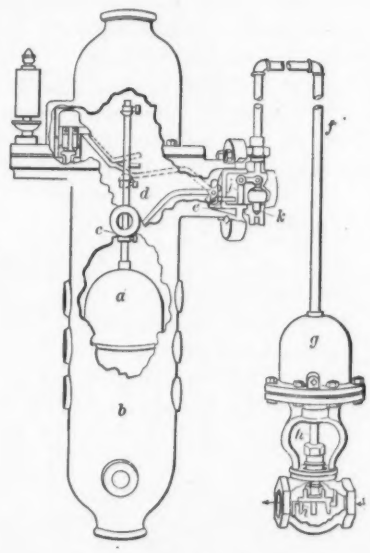
The injector does not lend itself to use in connection with a heater, as in the case of the pump. The action of the injector is dependent upon a supply of feed water at a temperature low enough to condense the steam in the injector at a rapid rate. If the water flows from a preliminary heater to the injector, the chances are that it will be so hot as to render the injector inoperative. On the other hand, if the discharge from the injector is sent through a heater, on its way to the boiler, it is extremely doubtful whether anything will be gained. For the stream emerging from the injector is at a high temperature, perhaps greater than that of exhaust steam, since it is heated by live steam, and consequently it would absorb little, if any, additional heat in its passage through a heater.

The desirability of maintaining a constant water level in a boiler has already been mentioned. In case the demand for steam is very uniform, and the boiler is not overloaded, it is possible to maintain fairly constant conditions by adjusting the speed of the feed pump by hand. When the load is very irregular, however, as in many electric power stations, regulation by hand is not feasible. Instead, automatic feed-water regulators are used.

There are several different types of regulator on the market at the present time. Although they operate on different principles, they one and all control the rate of feed to the boiler either by changing the amount of opening of the feed valve or by altering the amount of steam supplied to the feed pump.

One type of feed-water regulator is illustrated herewith. Here the feed valve is controlled by the float, *a*, in the water column, *b*. When the water level rises above the desired height the collar, *c*, is carried upward by the rising float and strikes the lever, *d*. The short arm of this lever then pulls open the pin valve, *e*, and steam at boiler pressure is admitted to the pipe, *f*, leading to the regulator valve. There is a diaphragm at the base of the chamber, *g*, and the boiler pressure, acting upon the large area of this diaphragm, forces it down, thus lowering the stem, *h*, and closing the valve, *i*. This shuts off the feed to the boiler.

When the water falls below the desired level, the float descends carrying the arm, *d*, with it, and seating the valve, *e*, tightly, preventing steam from entering the pipe, *f*. At the same time the



FEED-WATER REGULATOR.

projecting end of the valve, *e*, strikes the lower arm of the bell crank lever, *j*, raising the exhaust valve, *k*, from its seat, and permitting the steam to escape from the pipe, *f*. The pressure on the diaphragm in the chamber, *g*, is thus removed, and the pressure of the water on the under side of the valve, *i*, forces the valve open, and again admits water to the boiler.

The boiler feed pump used in connection with this regulator is always under steam pressure. So long as the valve, *i*, is open, the pressure in the steam end of the pump is able to overcome the pressure in the water end, and the pump continues to force water into the boiler. As soon as the valve, *i*, closes, however, the resistance to the motion of the plunger of the pump becomes equal to the pressure on the steam piston, and the pump is stopped. It starts again, as soon as the regulator valve, *i*, opens, and relieves the pressure on the water end.

The amount by which the water level varies is determined largely by the adjustment of the collar, *c*, on the stem of the float, *a*. The smaller the vertical movement of the float required to change the valve, *e*, from its open to its closed position, the less will the water level fluctuate. With a device of this nature attached to a boiler and kept in proper working order it is impossible to burn the tubes through lowness of water level, or have the water rise so high as to be carried over to the engine with the steam.

LETTERS ON PRACTICAL SUBJECTS.

DEVICE FOR INDICATING THE HEIGHT OF WATER IN A TANK.

In the October number of the ELECTRICAL WORLD, G. F. M. asks if you can suggest some electrical device whereby the height of water in a tank could be made known in the station several thousand feet away. Your answer suggests the use of an ammeter with a resistance. The writer has built a much simpler apparatus which can readily be installed and which does not involve the use of an ammeter. The indicator mechanism consists of three iron electromagnets placed 120 deg. apart with pole piece projecting inward, formed in an arc of a circle and enclosing a space in which is a rotatable armature. The armature consists of an aluminum disc carrying a segment consisting of a piece of iron which extends over 120 deg. When the current traverses any one of the electromagnets, the segment sets itself opposite the pole of the magnet energized, and as the neighboring coil is energized the segment moves forward to a mid position between the two magnet pole shoes, and as the current on the first energized coil is discontinued, the segment moves forward directly opposite the pole of the energized coil. In this manner three energizations, one of each magnet, causes the rotatable

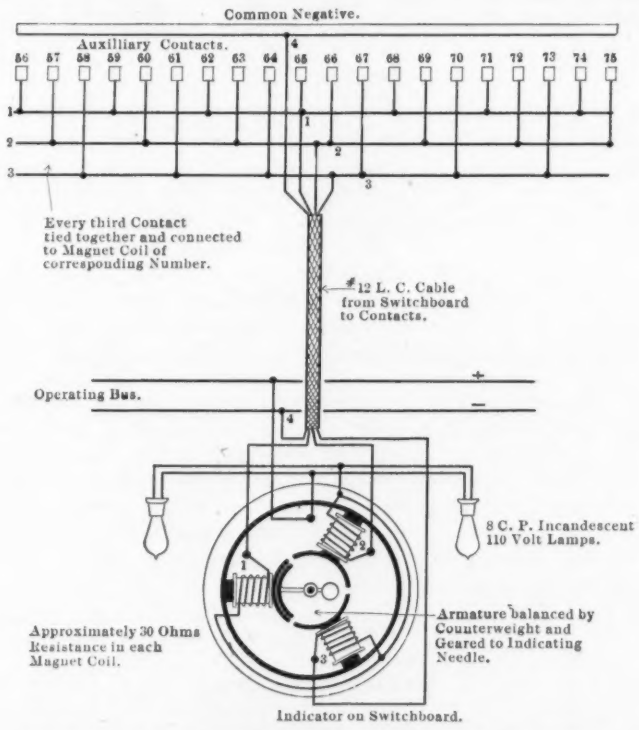

Common Negative.
Auxilliary Contacts.
56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75
1
2
3
4
Every third Contact tied together and connected to Magnet Coil of corresponding Number.
12 L. C. Cable from Switchboard to Contacts.
Operating Bus.
+
−
8 C. P. Incandescent 110 Volt Lamps.
Approximately 30 Ohms Resistance in each Magnet Coil.
Armature balanced by Counterweight and Geared to Indicating Needle.
Indicator on Switchboard.

DIAGRAM OF CONNECTIONS OF INDICATOR FOR WATER TANK.

member to make one complete revolution. If now, the magnets are energized again in the same order, another revolution is the result, and likewise any number of revolutions of the moving member may be produced. The apparatus, at the point to be indicated consists of a number of small electrical contacts, arranged in any convenient manner so that a float in the tank makes contact with them. For example: If the water is rising, the contacts are made in successive order, thus energizing the coils in the indicating mechanism in one direction, and causing the rotatable member to advance by definite steps.

The electrical connections for the passage of the current from the tank, or dam, where the water is to be indicated to the station, are arranged as follows: Every third contact, or the beforementioned series, is connected to a common wire which leads to one of the electromagnets of the indicator. The remaining terminals of the three coils in the indicator are connected together and earthed. One terminal of the circuit, supplying the energy for the moving of the indicator, is also earthed, while the other terminal is fastened to the arm which is moved by the flow.

The apparatus as built consumes ¼ of an ampere at 110 volts. The coils can, however, readily be wound for such a low voltage that several dry cells, or gravity batteries, could be used to supply the current. In this type, which is designed particularly for switchboard use, it will be noticed that two small lamps are mounted on the upper portion of the case, which the current traverses before passing through the coils of the instrument. This gives the switchboard operator an indication as to whether the circuit through the instrument is in working order; and also, due to the fact that the two lamps are in parallel, prevents the instrument from falling out of step, in case either of the lamps burns out. The indicating dial carries the numerals which register the indication. This may be made with either large or small divisions, depending upon the number of indications it is desirable to register and the range through which an indication is to be given. By changing the ratio gears, between the spindle of the rotatable member and the pointer, it is possible to secure a great flexibility of range and indication. The enclosed sketch shows the electrical connections.

CHICAGO, ILL. W. E. WEINSHEIMER.

DUPLICATE BOILER FEEDERS.

There are many steam plants which are provided with but one boiler feeder; therefore, if that fails the engineer has no choice in the matter, but must shut down the plant.

This is neither wise nor economical, for as a general rule the cost of shutting down for a few hours is sufficient to pay the entire cost of putting in a duplicate boiler feeder. This does not necessarily mean that the firm is making money fast, as some suppose, because a large part of the expense per day continues if the machinery is idle, while the entire income ceases. An interesting illustration of this matter came to my notice some time ago, where a plant of nearly 1,000 hp was fitted with a power pump, a direct-acting steam pump and an injector.

The power pump was generally used, but one day it broke down and could not be used for a week. The engineer started the direct-acting steam pump, but in a few minutes the packing in one of the water pistons failed, making it necessary to shut down that pump also, leaving only the injector to supply the boilers. Fortunately, that was large enough to supply the required amount of water, until the steam pump could be repacked. I have noticed that in some plants if one boiler feeder fails another is started so that the plant is kept in operation; but the engineer does not have the broken parts repaired at once, as he seems to think that as long as there is one that can be used there is no danger of being obliged to shut down. This is a mistake, as he should have the disabled pump repaired as soon as it can be done, for nobody knows how soon the other will fail, and if there are but two he will then be in trouble the same as if he had but one in the first place.

As a further illustration of this point in a somewhat different way, I will mention the case of an old-fashioned engine that I saw some time ago which was fitted with two governor belts. In case one of them broke, the other was intended to run the governor and prevent a fly-wheel wreck. After running nicely for a long term of years, one of these belts broke, and immediately the other failed, too. This was not because the load was too heavy for one, as the governor required only a little power, but was due to a coincidence that might have proved disastrous if the engineer had not been on hand to shut the throttle valve promptly.

These lessons teach that duplicate boiler feeders and other devices that are intended for emergencies, should always be kept in good repair ready for instant use.

NEWARK, N. J. CHAS. P. SMITH.

WANTED—DEVICE FOR LOCATING FAULTS IN CABLES.

In the February issue there was described an instrument by C. W. Petry for localizing faults on electric light circuits, etc. Some months ago I made an instrument the same as Mr. Petry's for the purpose of localizing faults on underground cables. I may mention that we are using concentric armored cables just laid in the ground about 15 in. below the surface. I thought

that by the use of such an instrument faults could be located rapidly, but I regret that my efforts have been a failure so far, as I can get no sound whatever through the receiver when testing an underground cable even with twelve cells. On open work, however, where the wires are apart and in exposed positions, the apparatus works very well. Now I know that there is a similar device being used for finding faults on underground cables, and if any of your readers could give me instructions on how to build such a device, I should esteem it a great favor.

Johannesburg, Transvaal. A. Marsden.

LEAKY BLOW-OFF VALVE.

A shop superintendent recently called with a tale of woe about the large amount of coal found necessary in order to keep steam up to the required pressure, the coal consumption seemingly to have been the subject of a steady and alarming increase. After looking the entire installation through very carefully, and finding no "nigger in the wood pile," it was almost fully determined to run an evaporative test in order to ascertain where the trouble lay, when it occurred to the writer that he had not seen any appliance for blowing off the boiler.

A search was made for this appliance, and it was found that the blow-off pipe passed into the ground inside the boiler setting, thence underground to an opening into a sewer, and, inside the opening in question, was located the blow-off valve. It was necessary to reach down into the sewer opening in order to open or close the blow-off valve, and even when in position for manipulating the blow-off valve it was impossible to see whether or not any discharge issued from the blow-off pipe.

A section of the sewer was dug out, so the end of the blow-off pipe could be seen, and it was found that a stream of water as large as the finger was escaping from the blow-off pipe all the time. This leak was very promptly stopped by grinding in the blow-off cock, and the coal consumption decreased at once to the amount of 1,200 pounds daily.

In order to prevent a further occurrence of this kind, the blow-off pipe was dug up and piped straight out from the boiler, through the boiler setting, then down again into the sewer. A bolted flange union was placed in the vertical pipe above the floor line, and a set of bolts inserted which would let the flanges lie ½ in. apart when the blow-off pipe was not in use. A tin spout placed between the flanges made leakage without discovery impossible, for any water coming down the pipe would be shunted by the tin out of the pipe upon the floor of the boiler room. When it was necessary to blow off some of the water in the boiler, the bit of tin would be removed, the bolts tightened with the fingers and the blow-cock opened. After blowing, the bolts were slackened again and the little tin spout again placed in position to deflect upon the floor any leakage from the blow-off cock. The device worked well, and in addition to promptly indicating any leakage from the valve in question, it also promptly indicated the improper closing of the blow-off valve when any dirt or scale became caught and prevented the valve from closing tightly.

Cleveland, O. Charles Allen.

FAULTY LOCATION OF INTAKE.

The writer recently visited a large electric light and power plant which draws its feed water from a river close by. One of the generating units in this plant is a 1,500-kw steam turbine. This turbine was supplied from a separate set of boilers which had superheaters. Nevertheless, in spite of the superheaters, it would frequently happen that the boilers would foam and prime to such an extent that the water and steam would slow down the turbine 50 or 100 revolutions per minute below normal. This, of course, always meant that the turbine had to be thrown out of operation and steam engine units started to take its place. The whole cause of the trouble was in the faulty location of the feed-water inlet in the river. Feed water was taken from just below a big city sewer. This sewer water would frequently cause excessive foaming of the water in the boilers. This emphasizes the importance of looking well after the location of feed water intakes when drawing from a river near a large city.

Chicago, Ill. Jas. K. Thomson.

CIRCUIT BREAKERS AS CURRENT INDICATORS.

Figs. 1 and 2 show diagrammatically a method of adapting car circuit breakers to indicate current within pretedermined limits without their operation interrupting the circuit in which current is being indicated. The device finds practical application in testing car circuit breakers with the test breakers adjusted

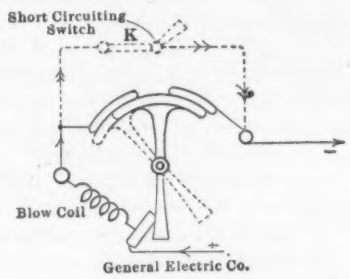


FIG. 1.—CIRCUIT-BREAKER AS CURRENT INDICATOR.

to known operating values above and below that at which the car breaker is to operate. In Figs. 1 and 2 the normal current path from + to — posts of the breaker is indicated by the full lines and arrow heads and includes the circuit-breaking contacts. By connecting in parallel with the contacts a conductor including a switch, *K*, as indicated by the dotted lines, the breaker can be used as a signal. With *K* closed the handle will fly over the instant the current attains the value for which the breaker

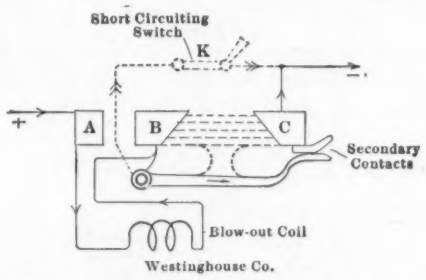


FIG. 2.—CIRCUIT-BREAKER AS CURRENT INDICATOR.

is set, but the circuit is not opened because the current has an alternate path through the short-circuiting switch. A number of breakers so arranged and connected in series can be used to indicate a number of approximate current values. The sensitiveness of Westinghouse breakers is much increased by removing the throw-off spring and main contact. The G. E. breakers are improved by seeing that the interference lugs are squared on the abutting ends without figures.

New York City. Edward Chilton.

FAULTY FUSE PLUGS.

A lot of 6-ampere screw fuse plugs were recently returned to the dealer with the statement that they were "no good." No other explanation was given, and new fuses were asked for in their stead. Finding that the returned plugs tested out all right, the electrician sent a man to his irate customer in hopes of ascertaining the cause of the trouble. Upon trying some of the rejected plugs in the socket in which they were to be used, the astonishing state of things was verified to the extent that none of the rejected fuses would permit current to pass. Finally, after repeated trials, one plug out of twelve, was found which would permit current to pass, and this plug only became operative when it was screwed very tightly into its socket. This at once gave a clue to the trouble and upon a close examination of the porcelain base, it was found that the screw thread was slightly defective and the plug was prevented from screwing in far enough to establish contact, owing to a drop of solder with which the lead fuse wire was secured to the outer brass shell of the plug. A very little work with a pocket knife removed sufficient of the solder to allow the plug to be screwed properly home, whereupon the lamp was found to glow at full candle power.

Worcester, Mass. T. B. Stratton.

A STRANGE GROUND.

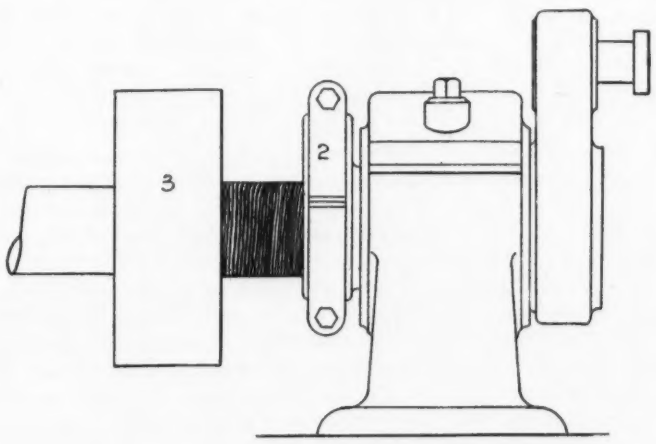
Considerable annoyance was caused by the auto-starter on a 440-volt induction motor in our machine shop. The starter-case and handle were charged with full voltage, which gave the operator a severe shock when he attempted to start the machine. The cover and oil pot were removed from the starter and a thorough examination made of all wires, for any broken insulation or bare spots. When a ground test was made on the starter it showed at once that current leaked across a path of dust that had settled on the switch drum and blades and all parts inside the starter-case. From the path made by the dust the handle was subjected to a tension of 440 volts. This dust proved to be flake graphite that had sifted through the joints of the case. Inasmuch as the cast-iron cases fit very tightly it is strange that so large an amount of graphite could have found its way into the case. An investigation showed that graphite had been kept near the starter, and what with frequent handling and a little draft, some graphite was deposited on the case and gradually worked its way through the joints to the interior. A blast from the air hose helped to clean away the dust; but the switch drum had to be scraped with a knife for the dust had been burned fast. New oil was also placed on the oil pot. Another ground caused by graphite settling in a screw hole in the end of the handle of the disconnecting switch was also removed. Needless to say no more shocks were obtained by the operator when starting the induction motor.

NEW YORK CITY. H. R. BAILEY.

AN INGENIOUS REPAIR JOB.

Some time ago I visited an engine room and seeing a small rope closely wound around the crank shaft of the larger of two engines, as shown in the illustration, I asked why it was there. The eccentric, 2, operated the valve gear in the usual way, and at the same time served as a collar to prevent the crank shaft from moving endwise too far.

The engine was overloaded, and as the engineer did not want the shaft to always run in exactly the same places in the bearings, he had the collar and eccentric set so as to allow room for the shaft to move more or less. As a high steam pressure was carried, this lost motion allowed the shaft to move quickly as far as possible, and this finally caused the set screw in the eccentric to lose its hold, with the result that the shaft moved too far. This engine is used 24 hours per day, unless mismanagement in some of the departments makes it necessary to shut down; no time could, therefore, be spared for repairs, but the engineer was equal to the emergency.



AN IGENIOUS REPAIR JOB.

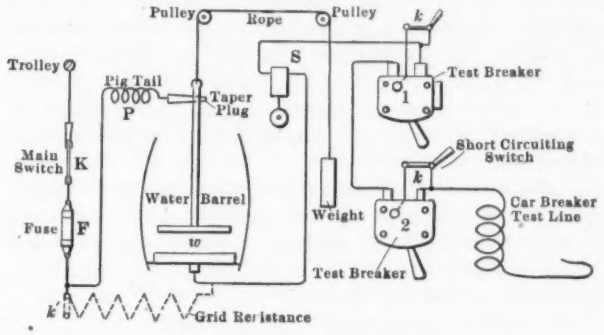
A large governor pulley, shown at 3, was firmly held in place by set screws. Several pieces of wood about the size of a common lath were cut the right length to fit snugly between the eccentric and the pulley, and held there by a cord. A ball of small rope was then secured and one end of it fastened to the shaft. The engineer turned the engine slowly, while an assistant held the small rope firmly and letting it run out as fast as wanted, wound it tightly around the shaft and pieces of wood until the latter were firmly fastened in place. The other end of the rope was then securely tied, thus causing the governor pulley to assist in holding the shaft from moving endwise more than it ought to.

As a general rule such repair jobs are not recommended, because they are not substantial; in this case, however, the plan answered every purpose, until more permanent repairs could be made, thus saving the delay and expense due to stopping the machinery.

PROVIDENCE, R. I. JAS. M. BERTRAM.

CAR CIRCUIT-BREAKER TEST.

The periodical test and adjustment of car breakers in situ is important as a protection to apparatus and as a measure of precaution recognized by juries. This feature of inspection has not been adequately covered on most roads, especially large ones, owing to the time required to get correct results. Where a road has a standard motor equipment the car breakers can be quickly tested in place by a method, the connections of which are indicated in the diagram: Here two test breakers,



CAR CIRCUIT-BREAKER TEST.

1 and 2, are mounted on a switchboard. Assuming that the car breaker is to be set to act at 250 amperes, one test breaker is adjusted to act at 225 and the other at 275 amperes, this adjustment being made with the aid of an ammeter. A main switch, *K*, a main fuse, *F*, a water barrel, *W*, the plunger of which is counter-balanced, the two test breakers and a long flexible test cable ending in a hook or clamp according to local conditions, are connected in series, as shown. The test can be made easiest where proper conditions exist for hooking on to both sides of the car breaker to be tested. Thus the breaker wires can be bared for an inch to take clamps, one on the end of the test cable and the other on a second short cable to be grounded to the rail. If no facilities exist for doing this, pull down the pole of the car, the breaker of which is to be tested, cut out all motors in the controller, place the controller on the last notch, apply the brake and hook the test cable on to the trolley wheel. In any case on closing the main switch current will traverse the car and test breakers in series. The current is then increased by lowering the water barrel plunger. If the car breaker operates between the two test breakers its adjustment can be passed. If it operates before the No. 1 test breaker, its armature tension must be increased. If it operates after the number 2 test breaker its armature tension must be decreased. Ordinarily, operation of the No. 1 breaker first would interrupt the circuit and interfere with the test; to prevent this a third wire is so connected as to place switches *k* in parallel with the breaker contacts. If switch *k* is closed on a test breaker, the handle will fly over as usual when the current reaches the value to which that breaker is adjusted, but the circuit will not be opened because of the alternate path provided by *k*. With *k* open operation with the breaker opens the circuit. Where several capacities are to be tested, more test breakers are connected in series; all of the short-circuiting switches are then closed except those on the breakers set to a capacity exceeding that to be tested. With the Westinghouse type of breaker, the sensitiveness and certainty of operation at a certain value is greatly increased by removing the main contact and throw-off spring and depending on gravity to pull the auxiliary contact to the off position. Where there is room for a large water barrel or box and the line voltage is kept near

standard there will be no difficulty in getting sufficient test current from salt water. If one barrel or box is insufficient, use two in parallel. Where the line voltage varies between wide limits the smoothest method is to connect in parallel with the water resistance and including an independent switch, a grid resistance, as indicated by the dotted lines, to give a current a little less than the test current required, then use the water resistance for increasing it to the desired value.

This test has been in practical operation for seven months and has been found much quicker than any ammeter method. At first the adjustment of the test breakers was checked weekly with an ammeter, but the interval has been increased to six weeks, because the adjustment was found to maintain.

Brooklyn, N. Y. Henry Schlegel.

ELECTRICITY AND EXPLOSIVES.

"Blessed is he who expects nothing, for he shall not be disappointed of his hopes" is quite a sage expression, and it expresses to a dot the manner in which many things happen in mechanics and engineering. A certain man was engaged in excavating for the foundations of an addition to his power plant and found it necessary to do considerable blasting. Dynamite was being used and it was exploded by means of fuse. Considerable time was lost in waiting for blasts to go off, and the owner, having once seen dynamite exploded by a little magneto rigged in a box with a push-down handle, conceived the idea of firing the dynamite in his excavation by means of electricity from the factory power circuit.

To this end, electric detonators were procured and several charges were placed in holes in the excavation and connected with each other by wire. Instead of connecting the several exploders in series, the gentleman ran two long wires among the holes and attached all the detonator wires in multiple, exactly as if he were connecting a lot of incandescent lamps. Then he carried the wires to the outer poles of the main motor switch, connected them, and, calling to know if everything was ready, invited several persons present to watch him give a practical exhibition of his expert knowledge of electricity. He closed the switch and the result is left to the reader's imagination. It is in order, however, to remark that the dynamite went off, and so did the big fuses on the switchboard, likewise those whom he had invited to witness his folly.

Wilmington, Del. Frank Joslin.

SOME STEAM TROUBLES.

A small horizontal tubular boiler was recently reset by the writer, the original setting having fallen down during the operation of the boiler. At some time or other, there seems to be a remembrance of a picture of a horse which had every known disease which can afflict the equine race. It seems as if a picture of the boiler as originally set, would show everything which could possibly afflict a steam boiler. Without going into detail, it may be stated that the boiler was set with a solid wall, the outer wall, and its air-space having been omitted entirely. The rolls under real suspension lugs, were placed lengthwise of the boiler, the grates were raised at their rear end instead of being lower at that point, the water column was attached bottom side up, the space between boiler and bridge wall, was circular and only six inches from brick wall to boiler shell. There were no buck stays whatever, and the top of the boiler was uncovered and open to the air.

In resetting the boiler, the writer found that a constant fight was necessary with the masons who were determined to make one dab of mortar serve for three bricks. The removal of many bricks from the wall at different points in the same, revealed the fact that the masons had evidently been educated, at some time or other, as waiters in a restaurant. The reason for this assumption was found in the condition of the mortar under the several bricks removed for inspection, from time to time at different points of the wall. Each brick seemed to rest upon about three points of mortar—just as the waiter carries a tray on the ends of three fingers.

After watching the masons as closely as possible, and heading them off in a number of faulty moves, the boiler setting was finally completed, and fire started in the furnace to dry out the green brickwork. Steam was gotten up in due time, and the boiler, in keeping with its previous record, promptly pushed out the front end of the setting and took the cast-iron boiler front with it, stack and all, for the stack was carried by a plate on top of the brickwork.

Investigation revealed the fact that the brickmasons had so built the back arch that the curved iron beams which supported the fire brick, were placed solid against the boiler head, while the other ends of the curved beams were set solid in the rear wall of the setting. The lugs under which the rollers had been placed were also set solid in the masonry and had no chance to move at all.

The lugs on this boiler were made of cast steel, each being in two parts, the portion which rested in the wall being slipped over the part which was riveted to the boiler. It was found that the lugs at the front end of the boiler moved very easily on the riveted-on portions, and consequently, the anchoring of the back arch bars, and the sliding of the front lugs, had permitted the boiler to expand forward, instead of toward the rear, and consequently, as the rear wall was much more solid than the front end wall, the latter was pushed out of place and the boiler expanded toward the front instead of to the rear as desired. It was necessary to cut out the back arch-bars, rebuild the arch with proper provision for the sliding of the arch bars, the anchoring of the boiler front by means of bolts extending to and through the rear wall, and the wedging of the front lugs in such a manner that the portions of the lug could not slide one upon the other. This done, the boiler stayed in place, and there was no more broken or cracked brickwork.

As stated above, no buckstays were included with the original fittings of the boiler, hence it was necessary to provide ten of these very necessary articles before the boiler could be properly set. Castings cost five cents a pound in this part of the country, and a 9-ft. buckstay of sufficient weight to be worth having, will weigh close to 200 pounds, making the set of ten buckstays cost about $100. As no railroad iron, or channel or angle iron could be obtained, the writer hit upon the somewhat novel expedient of using 4-in. steam pipe for buckstays, at a cost of 50 cents a foot, or about $50 for the set of ten. This estimate made the owners feel much better and ten pipes of the required length were ordered, and holes drilled for the rods, a hole close to the end of each pipe, and ¾-in. bolts put entirely through the setting, both above and below the boiler. The pipes were filled with cement for a distance of 6 in. at each end, to prevent any tendency to flatten out beneath the strain of the bolts. The pipe buckstays presented a most solid and imposing presence and added much to the appearance of the boiler setting. In fact, the writer is led to regard pipe buckstays as far preferable to the cast iron article, or to the double angle-iron, built-up stays.

A kettle trap having been put in to drain water of condensation from a steam circulation, considerable trouble was experienced in making the trap work properly under a boiler pressure of 130 pounds. At 100 pounds' pressure, the trap worked all right, but when the pressure was increased to the highest figure, the trap seemed utterly unreliable and could not be depended upon to discharge when filled with water. A good deal of "monkeying" was done by the engineer with indifferent results, and the writer finally took hold of the matter and went into the problem in a systematic manner.

It was soon found that the pressure of the steam on the area of opening covered by the valve attached to the trap kettle, was more than the weight of the kettle (when submerged) could be depended upon to overbalance. The unbalanced area of valve opening was found to be very nearly .33 square inch, under 130 pounds boiler pressure, amounting to a pressure of about 43 pounds. The kettle was next removed from the trap, submerged exactly as when working, and weighed when thus submerged and found to balance 33 pounds.

The result given above shows that the unbalanced steam pressure is 10 pounds greater than the power available to open the valve by causing the kettle to sink. The power to keep the valve closed was thus 10 lb. more than the opening power; therefore the trap failed to work properly. The remedy which immediately suggested itself, was found to be effective and prompt. All that

was done was to drop into the bottom of the trap a ring of flat iron which weighed about ten pounds when weighed under water. Thus the necessary opening power was added to the trap and no further trouble was experienced.

BOISE CITY, IDAHO. JAS. F. HOBART.

TROUBLES OF A REPAIR MAN.

Experience in practical electrical work covering a period of twelve years has convinced me that there is no branch of electrical work which offers greater opportunity to gain good practical knowledge than hunting troubles in small motors and dynamos. The few examples which follow may be of interest to your readers as showing the difficulties under which one often has to work. The first case will probably be recognized by many. The machine in question was a 5-kw, 110-volt, compound-wound dynamo which was used for supply lamps in a refrigerating plant with electricity. The superintendent stated that the machine failed to generate and this was probably due to a rough commutator or to loose field connections. When I arrived at the plant, I examined the commutator; but aside from being slightly eccentric it did not seem to be in bad shape, not showing any roughness. I then proceeded to find the loose field coil connection; but after going over every connection on the machine and on the switchboard, I could find nothing wrong with the connections. I tried all schemes during the remainder of the afternoon to get the machine to generate, sand-papering the commutator, moving the brushes, reversing the field coil connections, etc., but to no avail. I then went to the hotel for supper and the refrigerating plant had nothing but lanterns and candles to supply light for the night. Next morning on the way to the plant, I purchased two dry batteries and disconnecting the compound winding and running the machine as a plain shunt-wound dynamo, I connected the two batteries across the terminals of the compound winding, whereupon the dynamo picked up as though nothing were the matter. After running this way for a few minutes, I shut down the machine, disconnected the batteries and connected the coils up as usual. When the machine was again started it generated current properly and carried the load without trouble. After waiting for an hour or more to make certain that the dynamo was all right, I was about making up my mind to leave, when the lamps gave a few convulsive flutters and were extinguished. I now tried all the ideas over again, including the use of the dry battery in an endeavor to get the machine to work again, and finally removed the armature to have the commutator turned down, although it did not seem possible that the trouble was in the commutator. After the commutator was turned down and replaced, the machine gave no trouble.

A subsequent experience of the same kind tends to show that a rough or eccentric commutator may be the cause of failure to generate in low-voltage machines. I had another trying experience with a small motor. A 10-hp, 500-volt motor was geared to a triplex pump in a mine in Ohio and the motor became so hot that it smoked. The armature had been removed from the motor and lay at the bottom of an abandoned shaft 40 ft. deep. To reach it we had to slide down an inch rope. The commutator was very badly burned and pitted due to excessive sparking. As the water in the mine was approaching a dangerous level it was imperative that the motor and pump be placed in operation as quickly as possible. We loaded the armature on a car at the foot of the shaft and transported it back into the mine about 1,200 ft., which was as far as the track ran. From here we had to carry the armature another 200 ft. to the motor room, and considering that the motor was liberally rated and that the roof of the mine was so low that one could hardly stand upright, the task was not an easy one. We replaced the armature in the motor and upon starting it discovered that all other lighting outfits in the room were superfluous as the brushes gave a very good imitation of an arc lamp. When the current was shut off an inspection of the brushes showed that the set screw which held the brush holder in place had become loosened and permitted the brushes to shift to a position considerably ahead of the neutral point, thus causing the excessive sparking. After adjusting the brushes to their proper position, the motor ran fairly well with the exception of the sparking due to the roughened commutator. We ran the motor during the night to reduce the water level to a safe point and then removed the armature and brought it up to daylight. We then drove seven miles to a machine shop over mountainous roads and when we arrived at the machine shop there was no steam up; so we had to take turns at running the lathe by hand to turn the commutator down. By the time we returned to the mine and had the armature in service again it was almost midnight; but as it worked nicely we felt repaid for the hard day's work.

NIAGARA FALLS, N. Y. E. C. CHANNING.

SOME INDUCTION MOTOR TROUBLES.

The writer recently observed some circumstances which may well serve as "awful examples" of how not to do it, and which may be cited as valuable negative information. In connection with a 75-hp induction motor the installation was in a small room supposedly dust-tight. The cracks in the sheathing had all been carefully closed by means of pieces of tin, and several other precautionary measures were taken to prevent dust from gaining access to the motor room. After all precautions had been taken, the entrance to the motor room was arranged through a passage of which the floor, or the lack of floor, consisted of very dry and very fine sand, and very "sharp" sand it was, too. Any one approaching the motor room must walk 30 ft. over the dry sand, then step into the motor room and stamp a lot of fine sand off his shoes.

The construction of a board walk along the dusty passage would certainly prove a paying investment so far as the life of this motor is concerned, for the consumption of oil, even in the most excellent journal bearings, with which the motors in question are fitted, has very noticeably increased since the dust gained access to the motor room, and the temperature of the journal boxing is noticeably higher, thereby proving that a "dust carpet" is a very expensive acquisition for a motor room. In cases like this, the precaution of sprinkling and sweeping twice a day is a very profitable one, but in the factory in question no attempt whatever is made toward removing the quarter to one-half an inch of dust on some portions of the motor room floor.

The controller provided with the motor in question, has five positions for the lever, before throwing the lever to the running position. In spite of repeated warnings to throw the starting lever quickly from one notch or position to the next, the men using the motor here described, persisted in moving the lever very slowly from one position to the next in starting the motor. So great was the dwell in moving the controller that the power or speed noticeably decreased in some of the positions, before the lever was moved enough to cut in the next lower resistance. This course was persisted in, until one day there came a sudden puff of black smoke from the controller case, together with a strong smell of burned grease.

Nothing was said about the matter until one day the foreman incidentally remarked to the writer that the motor "lost speed between controller points four and five." Upon investigating the matter it was found that no contact existed when the lever was on point five, the contacts having been evidently burned down so far that they were unable to establish contact with each other. As a consequence, no current at all reached the motor while the lever was between points four and six, and, as the attendant wrongly moved the lever very slowly from point to point, there was a considerable decrease of speed after the lever left point four until it reached point six. But when the lever did get there and the running current got to the motor, there was a terrible jerk which yanked the belt with terrific force, shook the motor to the bottom of its foundation, and caused the line shaft to jump under the sudden and enormous application of force.

Some day, unless the contacts are repaired, and the starting lever is moved quickly from point to point, there will be a circus in that motor room. The arms of cast-iron pulleys are not designed to withstand shocks such as are imparted by the "skip point" method of starting, here described. The motor belt is leather, and is endless, but it will not stand everything. The pulley arms will break and the line shaft has already been aligned three times, having been pulled out of place by the sudden application of a tremendous force, as above described.

BALTIMORE, MD. SAMUEL L. BROWN.

QUESTIONS AND ANSWERS.

Can frozen water pipes be thawed out by means of direct-current at 110 volts? What special attachments are necessary? F. L. M.

It would be cheaper to do this work with current at a lower potential; but 110-volt current can be used. The best results are obtained by using a water rheostat to regulate the current. Aside from this the only instrument necessary would be an ammeter.

Will you kindly inform me what to mix with red lead to make it remain in place on a positive plate of a storage battery? In making some batteries I find that the red lead mixes with the battery solution. J. C. R.

The paste must be retained by some mechanical means. Commercial batteries have the grids so shaped that the paste is mechanically held in place. If you countersink the holes on both sides of the plate and press the paste in firmly, it will not be liable to drop out.

What causes the salts in a gravity battery to creep over and cover the outside of the retaining jar, and what effect has it on the battery? C. D. E.

All cells containing solutions of salts are subject to the evil of creeping. By this is meant the gradual crystallization of the salt on the inside of the containing vessel above the level of the contained liquid. Little by little this extends up to the top of the vessel and even over to the outside, and tends to short-circuit the cell.

Kindly give data for an induction coil capable of giving a 1½-in. spark. L. G. G. W.

The dimensions for such a coil are as follows: Length of core, 8 in.; diameter of core, 1 in.; gauge of primary wire, No. 14; internal diameter of ebonite tube, 1⅜ in.; external diameter of ebonite tube, 1 11/16 in.; approximate diameter over secondary winding, 3½ in.; distance between coil heads, 6½ in.; number of sections for secondary winding, 4; quantity of secondary wiring, 2 lb.; total area of condenser coil, 1,500 sq. in.

Kindly give me some formulæ for frosting and coloring incandescent lamps. D. C. R.

Dissolve one ounce of refined gelatine in a pint of water, and after boiling it add an aniline or a "Diamond" dye of the color desired in sufficient quantity to render the solution very dense in color. Dip the lamp bulbs in the solution while hot and after removing them dry them as quickly as possible. Repeated dippings and dryings will render the color on the bulb more dense. The lamp may then be dipped in a thin brass lacquer, or better still, in formaldehyde and again dried. This will render the coating waterproof. A colored collodion solution may also be used, or a colored varnish or a solution of water glass. Incandescent lamps may be given a frosted appearance by means of a sand-blast or by dipping them in a solution of hydrofluoric acid.

In a starting rheostat for a 5-hp, 220-volt, direct-current motor, how many contacts are necessary? (2) What is the total resistance? (3) How is the resistance divided, and (4) what size of "climax" wire should be used, when the coils are open but have little space for air circulation and the motor is started every 15 minutes? S. E. H.

The design of a starting box for motors varies with different makers and also with the character of service that the motor is to perform. A starting box to be used for starting a 5-hp motor from rest and accelerating it to full speed under any proper conditions met with in practice, but not for operating the motor at reduced speeds for longer periods than this, would have a resistance varying from 14 to 20 ohms. This would be divided between any number of contacts. The accompanying data is for a resistance box of 20 ohms total resistance divided between ten contacts. The resistance, beginning from the first contact, is apportioned as follows: 3.7, 3.24, 2.84, 2.48, 2.24, 1.77, 1.49, 1.17, .75 and .15. We have no data on "climax" wire and cannot, for that reason, give the size of wire.

Kindly let me now what is considered to be the best method for testing armatures for short-circuits? J. J. B.

The most convenient method of testing direct-current armatures for short-circuits entails the use of a special transformer. This test is known as the induction test. The armature completes the magnetic circuit of the transformer and is revolved slowly. A small tell-tale piece consisting of a light piece of sheet iron is held at the top of the armature. If there is a short-circuit this will be easily determined by the vibration set up in the tell-tale piece which can be readily felt by the hand. A device of this kind is one of the greatest money-savers in repair shops, etc., for determining whether a short-circuit exists in an armature before it is placed in the motor and makes itself known by a burn-out. For isolated cases where it is not desired to take the armature out of the motor, a screw-driver or other steel tool may be held between the pole pieces of the machine and near the revolving armature. If a short-circuit exists the tool will vibrate perceptibly as the short-circuited coil passes. The short-circuit will also heat the coil more than the others and in this way the coil may be detected by feeling the armature with the hand.

When the acid in a storage battery is weak, say 1.100 in specific gravity, what is the method of strengthening it; a strong solution or pure sulphuric acid? 2. Is it preferable to fill the cells before, during or after charging, the batteries being but two-thirds full? 3. After emptying, cleaning and refilling, do batteries require a longer charge than ordinarily? 4. What reading should one get on a battery of 44 cells when fully charged? G. G.

If the battery is new it will be noted that during the first part of the charge the specific gravity of the acid solution is somewhat lower than when the electrolyte was put in. The charge should be continued with the view of bringing up the specific gravity of the acid as near 1.300 as practicable. The maximum point cannot be reached upon a first charge, and not until the battery has been charged and discharged three or four times. If the cell is not new, it should be charged separately at a low rate, and if the specific gravity increases it is an indication that the cell has been run down lower than its fellows. If with additional charging the specific gravity does not increase, pure acid or a strong solution may be added depending on circumstances. The addition of a strong solution is preferable since by this means the specific gravity of the cell is more easily restored. 2. The batteries should be filled before charging. 3. A slight overcharge may be given. 4. The voltage at the start should be 95 and at the finish of the charge approximately 112. The latter voltage may vary, and a fixed voltage must not be considered in determining the end of the charge, but rather a maximum voltage, this being determined by noting when the voltage stops rising as the end of the charge approaches.

Is it possible in accordance with the article in the Electrical World of July 28, page 157, to connect together the like lines in a three-phase four-wire (one neutral) system of distribution fed by transformer banks of different capacities, when neither the primary nor secondary voltages of the circuits to be connected are equal through one being more loaded than the other; and if possible would not this serve to equalize the pressure or raise that of the lowest circuit? If so, why and how much, the secondary voltages being in one circuit 118 volts and in the other 107 volts? Would the neutral need a fuse, if at the connection the other lines are fused? The lamps used are for 115 volts. R. W. O'F.

The problem can be most easily solved by forgetting momentarily that three-phase currents are used and considering each transformer separately as though it were connected in a single-phase circuit. When two transformers are connected in parallel on both their primary and secondary sides, the division of load between them will depend entirely upon the separate local impedances (including primary and secondary resistances and primary and secondary local magnetic leakage reactances). If two transformers whose primaries are connected in parallel are connected to separate loads of such value that the secondary pressure on one is 118 and the secondary pressure on the other is 107 volts, then if the two secondaries are connected in parallel the resultant voltage will be somewhere between 107 and 118, depending upon the values of the combined local impedances of the two transformers. If the impedances of the two transformers are equal, the two transformers will divide the load equally, but the exact value of the resultant voltage cannot be determined from the limited information, that under the previous loads of unknown values the secondary e.m.f. of one was 107 and of the other 118. However, it may be stated that the resultant voltage would be approximately the mean of the two. With fuses of the proper value placed in both the primary and secondary circuits of the separate transformers, it will be unnecessary to use a fuse in the neutral wire.

CENTRAL STATION SALE OF CURRENT

Organization and Conduct of a "New Business" Department, Suitable for Central Station in Cities of 50,000 Population and Under.

The following is an abstract of a paper by Mr. James L. Wiltse, which received honorable mention by the committee of the National Electric Light Association in the contest for the prizes offered by the Co-operative Electrical Development Association:

It is assumed that a "new business" department is to be organized in a company which has had no separate department to take care of its commercial business. It will have charge of all present and prospective customers, excepting the collection of bills. The principal object is to increase and hold the business of the company.

The first thing in the organization of this department is the selection of a competent head who should be a man who has had central station experience, and one who realizes the necessity of tactful treatment with those with whom he comes in contact. He will be responsible for the acts of his solicitors, and it should be his duty to see that all possible efforts are put forth by his men in the direction of following up and securing new business. He also settles questions of rates, guarantees, line extensions and all the minor matters connected with the wishes and requirements of the public. He should take care of all complaints from customers and should also be capable of taking complete charge of advertising.

Having secured our contract agent the next important consideration is the selection of solicitors for outside representatives; as to these, two will be sufficient to start with. These men should have some experience with central station work and have a knowledge of light and power engineering. They should be paid a straight salary. This is more advisable than paying them on a commission basis, as better men can be secured by this method of compensation. Each solicitor should be given a certain territory. These men are to report at the office once a day, make a report of each call and the results, and issue all necessary orders to the proper departments to make connections, etc., and for care of business secured by them.

The contract agent should have an assistant to take charge of the office, see that the solicitors work and reports are kept up and take general charge of the details of the office. This man should be capable of taking care of all customers coming into the office.

There are two channels through which we should go to get business. One is through advertising, the other through the outside representatives or solicitors. Advertising is essential because it informs the public that you are after business. Advertising for this purpose simply means the educating of the public to the adaptability of electricity to the every-day needs of the office, the factory and the home. Advertise freely in the local newspapers, as the majority of the people in the small cities read them.

Another good form is in mailing literature in the form of pamphlets and circulars, relating to the many advantages and uses of electricity. Enclose with each a return post card, so that it can be signed and returned for the purpose of having a representative call. This not only advertises your product, but gives them a "lead." This system of advertising should be checked up, and where necessary followed up with more advertising as well as a personal canvass.

As a means of keeping present customers awake as to the many uses of electricity, a small paster should be attached to their bills giving a brief description of the articles you wish to advertise or place before them; such as fans, flatirors, heating and cooking utensils, etc.

Another good scheme is to erect an attractive electric sign outside of the office. This shows that the company believes in efficiency of electric signs, as well as helping to promote the sign business. An attractive office, fitted up with fixtures, shades, etc., giving ideas regarding illumination, and also an exhibition of electric cooking, heating and other electrical devices, will prove a very good advertisement.

The next and the best method of getting business is through the solicitors. We have two men to start out and as they have been given such a good lead through the advertising, it is so much easier for them to get the business, either through canvassing and answering inquiries or follow-up work on advertising.

With all central stations the peak load is generally in the early part of the evening, and it is therefore an important item for the company to secure business which will even up the load. To do this it is necessary for the business department to work on installations such as power and heating.

In order to develop the power business, the solicitor should be familiar with the other forms of power, and state their comparative disadvantage. They should also be able to lay out power installations in the most economical way, and see that customers follow suggestions and get the desired results.

Another good way to increase business if there are many small users of power who cannot afford to lay out the money for a new electric equipment, is to advance the cost of the motor or motors to him, which can be repaid in monthly installments. This means revenue for the central station, and should, therefore, be given special attention. The solicitors should keep close watch on all gas engines and when they break down or give trouble get on the ground and talk electric power.

In addition to the power business, there is a newer field for the use of electric current which will also help to even up the load on the company's system. This is electric heating. Of the revenue-producing heating devices the electric flatiron has already begun to show results to central station companies which have had the foresight to actively push its use. There are also heating and cooking devices which, while not great revenue producers, are good advertisers, and help to swell the gross receipts. The best method of increasing this business is to deliver these heating and cooking devices on 30 days' trial, and if the same are satisfactory they should be sold at practically cost. With the electric flatiron it is in most cases advisable to loan the iron to the customer, and the increased energy consumption will soon repay the company.

Besides the many advantages of electricity over the other forms of illumination, there is one especially important point to bear in mind in securing this business, and that is the proper lay-out of the lamps. It is, therefore, needful that the solicitors have a knowledge of illuminating engineering, as in some cases it is only by this method that customers may be secured and satisfied.

The electric sign business should be given attention and the company should furnish and install signs on the premises of customers free of charge. This method has met with much success in many central stations. The usual form is that customers are required to sign a contract with a minimum charge per month. The company should furnish time switches for signs where customers desire the sign to burn after the closing hours. It is to their interest to do this, as it not only means increased energy consumption, but induces other merchants on the street to make their places attractive by night as well.

The idea is for the central station to work up the matter of proper illumination and get the merchants in the city into a more liberal use of light, not only during open hours, but after stores are closed for the evening.

In a new department of this kind one must initiate an accurate system of keeping records and following up new business. To do this the solicitor should be provided with a small card index file, in which he should keep a record of all prospective business and see that it is followed up properly. He should note the date and result of every call. In addition to this he should make a separate report to the office of every call. Agents should be furnished with blank forms for this purpose. These should be of three kinds, each a different color; one form to be used

when a customer's application is secured, another form for prospective business, where customers will consider the use of electricity, and the other form for holding present business or other miscellaneous report. After checking these reports in the office, they should be filed, excepting reports where people are considering the use of electricity, which should be filed temporarily and followed up until contract is closed.

The following is a form which can be used for this purpose. All forms to be printed the same, but each form to have a different color:

SOLICITOR'S DAILY REPORT.

Location .....Present form power.....
Name .....Estimated H.P. required.....
Business .....Used for .....
Present lighting .....Will customer consider.....
Probable installation .....Remarks .....
Wired .....
Date..... Checked by.....Solicitor.....

In this way the solicitor's work can be checked up and every month a report can be made of the number of calls, and the amount and kind of business secured by him.

A card of all customers should be kept as follows:

CUSTOMER'S CARD.

Address..... Business.....
Name .....
Application dated.....Rate.....Solicitor.....

Order Issued.	Installation	Connect or disconnect.	Completed.	Remarks.
.....				
.....				

This card can be used to keep a complete record of the customer's installation, etc., and any other records necessary can be entered on the other side of the card.

All records of this office should be filed according to location. Two card catalogues should be kept, one for connected and the other for disconnected customers.

The solicitors should make out the working orders for the business secured by them. After being checked and recorded in the office, the order should then be approved by the credit department. After it has been properly approved it is forwarded to the installation department to do the work.

The office is to keep a record of all business secured and this can be done by keeping a report showing each day's business, as follows:

REPORT OF BUSINESS SECURED.

Name.	Address.	Incs.	Arcs.	Power.	Misc.	Remarks.	Solicitor.
.....							
.....							

These items can be added up each day, and at the end of the month a report can be readily made showing the business secured during the month.

To operate a department such as outlined here, the cost will be approximately as follows:

Salary of contract agent, per year	$1,800.00
Two solicitors, each $18 per week, per year	1,872.00
One clerk $12 per week, per year	624.00
For advertising, per year	2,000.00
Total	$6,296.00

Three-Cent Rate for Electric Heating at Ludington, Mich.

We have received the following interesting letter from F. W. Hawley, manager of the Stearns Lighting & Power Company, of Ludington, Mich., in answer to an inquiry as to the rate of 3 cents per kw-hour which that company is making on electric heating and cooking:

"We are making a three-cent rate, with 10 per cent discount, and a minimum charge of 30 cents per month. The reason we are putting this rate into effect is that we wish to get into the cooking field, and in a town of this size, where so many of the people are unable to pay excessive rates, it is necessary for us to compete with gas. There is no use going into the field unless it can be done to some extent, and we appreciate that it cannot be done, on high rates.

"We are particularly well situated to make low rates. Our situation in that regard is as follows: We are operating a sawmill, planing-mill and salt block, and the electric light plant is operated in connection therewith. We get practically enough refuse fuel from the sawmill to furnish steam for the sawmill, planing-mill and electric light plant. This steam is all generated in one power house, and is piped to the various engines in the different plants, all of them being within a few hundred feet of each other. After being used in the various engines, the steam is exhausted into the salt block, and we make about 1,500 bbls. of salt per day, entirely from exhaust steam. If we were not using it in the electric light engines we would put the live steam into the salt block, and we figure that all we lose in this operation is the radiation from the pipes, and we can make practically as much salt as we could were we using the live steam. With this combination we are able to generate electricity for practically nothing. The steam costs us nothing, nor are we under any expense for firemen.

"The reason we put in a minimum rate of 30 cents, on heating and cooking is merely to compete with gas, which is at the same rate. It does not matter particularly so long as you get the cooking appliances installed, as of course they would use considerable more than that quantity.

"On account of the newness of this form of cooking and the expense of the apparatus we have not gone into it very extensively yet, but the advertising we have done we believe will result in a large trade in the future. As we are making power rates even lower than this, there is no reason why we should not make such a cooking rate, as it is used during the day, when we have no lighting load. It is even cheaper to install a cooking outfit than it would be motors, because the cooking outfits go entirely on light transformers, and lighting wires, while it is almost invariably necessary to install extra wires and transformers for power service.

Electric Wiring for Old Houses.

The current issue of *The Illuminator*, published by the Cleveland, O., Electric Illuminating Company, contains an article entitled "Electricity in Old Houses," from which we extract the following:

Some are under the impression that in order to equip an old house for the electric light, it is necessary to cause much damage to the interior, and that the cost for wiring in many instances is prohibitive. This, however, is not the case. On the first floor, nothing is disturbed, for the various outlets are reached from the second floor and from the basement. If it is necessary to make an outlet for the center fixture in the parlor, for instance, the wireman removes a strip of flooring in

METHOD OF RUNNING ELECTRIC WIRES THROUGH JOISTS.

the room above which exposes the joists upon which the floor rests. He bores two holes through each of these joists, inserts porcelain tubes and then slips the wires through to the outlet, after which the strip of flooring may be replaced so neatly that it is afterwards difficult to locate which one had been removed. Should the flooring on the second floor be of hard wood, an operation called "fishing" is resorted to, which necessitates the removal of part of the baseboard of the room.

To carry the wires to the outlets on the side walls, a small puncture is made in the wall, and the wires either dropped between the walls from the floor above, or pulled up from the basement, which is accomplished by means of a cord lowered with a weight on the end. Outlets for switches and base receptacles are provided for in like manner.

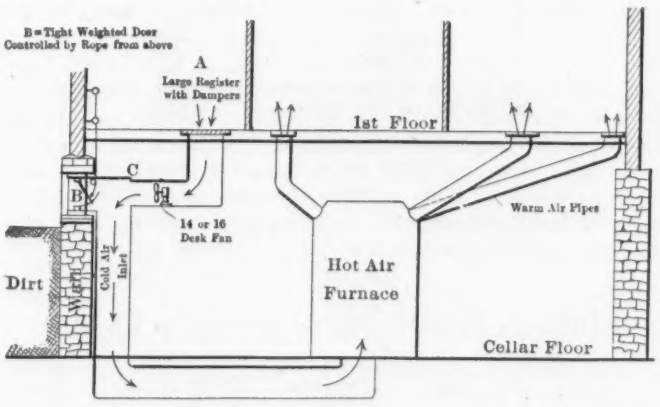
A baseboard receptacle is one of the greatest conveniences of electric lighting. It may be located wherever there is a possibility of placing a lamp, for all that is necessary is to insert a plug and the current may be carried to a distance limited only by the length of the cord. A receptacle behind the sideboard in the dining room is often desirable in order to operate an electric fan, or to light an attractive candelabrum, and one in a bedroom near the bed is useful for the services of a little electric stove to keep fluids hot, a lamp, or a heating pad, which is far more satisfactory than a hot water bottle. No matter how delicate be the decorating on walls or ceiling, when the wiring is completed there remains not a spot or scratch on any part of the house. A small house may be wired for from thirty-eight to fifty dollars.

Another Opportunity for Day Load.

By F. N. JEWETT.

More residences of the better class in this country are heated with hot-air furnaces than by all other methods combined. Strange as it may seem, but few furnace-heated houses are entirely or satisfactorily heated. There are always some rooms which will not at certain times if at all heat, no matter how much the fire is forced. This failure is due in some cases to too long pipes, or too small pipes, but in most cases the direction and strength of the wind outside is the real cause.

The only force which causes the hot air to pass up the pipes and registers is the force of gravity. Air, when warmed, expands. Hence, a given volume of warm air is lighter in weight than the same volume of cold air. This difference in weight is so slight that but little counter force is required to nullify it and stop circulation. A strong wind usually causes one or more cold rooms on the side of the house from which the wind blows. And in many cases when the wind is in a certain quarter relative to the location of the fresh air intake, the whole system fails to work, warm air frequently passing out the cold-air box.



METHOD OF IMPROVING THE SERVICE FROM A HOT-AIR FURNACE.

The writer in his own residence had all the difficulties above mentioned and devised the following scheme which operates satisfactorily. Herewith is given a diagrammatic cross section through the basement and lower part of the first floor of the house. The usual fresh air intake or cold-air box, *B*, is equipped with a swinging door weighted so as to be self-closing. Connected to this door is a rope, which passing over pulleys and through the floor, permits opening and closing the fresh-air intake from the first floor.

At *C* an opening was made in the cold-air box and a round galvanized iron duct 16 inches in diameter was run out and up to a large register, *A*, placed in the first floor. In this duct a 16-inch desk fan was installed. The register, *A*, may be placed in any out-of-the-way corner, and in the hall under the stairs is usually the best location.

With this arrangement it will be seen that should any one room or any part of the house fail to heat properly, the door *B* may be closed, the register *A* opened, and the fan operated. Then the cold air on the floor of the house is drawn down through the register *A*, blown rapidly through the cold-air box and mechanically forced up through all the warm-air ducts and registers, and the heating not being dependent upon gravity, the air must go where desired. As a consequence it will be found that the rooms that never before were warmed can be controlled and warmed to a nicety; and not only will the desired end of warming be accomplished, but by the operation of the fan an actual saving in cost of heating will be secured.

This will be readily seen when it is considered that air when taken in from outside at say 0° Fahr. through *B* must be warmed in the furnace at about 120° Fahr., at which temperature the air passes into the house. It then leaks out at from 60° to 70° Fahr., so all the heat put in the air to bring it up from 0° to 70° accomplishes nothing so far as warming the house is concerned and is wasted on "all outdoors."

However, when *B* is closed and *A* is open and the fan is in operation, the air supply comes from the floor of the house at about 60° and only has to be warmed from 60° to 120° to accomplish the same useful heating effect in the house. Therefore but about one-half the fuel is required.

It may be argued that with the fan in operation and the air recirculated no ventilation is secured. It will be found, however, that in most of our American houses there is leakage enough around doors, windows, etc., to provide required ventilation.

The fan need not be operated all the time; it will suffice to operate it in coldest or windiest winter weather when trouble is ordinarily encountered in satisfactory warming. The fan will also be found of great value early in the morning in rapidly warming up the house, which usually has cooled off during the night.

It is the writer's practice on retiring to close off entirely the furnace. By morning the house will have cooled down perhaps to 40 deg., and by opening the furnace and operating the fan the house may be brought up to 70 deg. in from thirty to forty minutes. Without the fan this would take from one and one-half to two hours with a corresponding extra amount of coal. For the remainder of the day the house temperature may be maintained with a surprisingly low fire. The cost of operating the fan will be more than earned in the fuel saved.

The fan may be installed in such a manner as to be easily removed in the summer time for use elsewhere and replaced in winter, so that the consumer may have the use of the fan the year round. The plan outlined appears to offer an opportunity for the central station manager to work up a very profitable winter fan business and also to show his friends how to make satisfactory what now are unsatisfactory heating plants.

Electric Pumping from Scattered City Wells at Lincoln, Neb.

The city of Lincoln, Neb., obtains its water supply from three different wells, and it has heretofore been necessary to maintain three separate steam plants for pumping from these wells. Plans are now being carried out to do all this pumping with electrically-operated pumps supplied with power from the city electric light plant. Centrifugal pumps driven by induction mo-

tors are used. One of the pumps already in place is of the vertical shaft type and considerable trouble has been experienced with heating of the thrust bearing. Such trouble would not, however, appear to be inseparable from such a type of pump, as vertical shaft centrifugal pumps with pump blades designed to float the load of shaft and armature have been successfully employed for many years in irrigation pumping in California. At another well in Lincoln a horizontal shaft centrifugal pump is to be installed.

A Chicago Advertisement for Residence Business.

The Chicago central station companies in going after residence business are trying hard to dispel the old idea that electric light

A Mistaken Idea About ELECTRIC LIGHT

Strangely enough there are people who feel that electric light is expensive. They seem to argue that because it is so much superior to any other illuminant therefore it must be more costly to use. It is not!

The Cost is Lower

than for any other form of lighting when you consider the efficiency of electric light — the actual candle power available for use — and the saving to decorations in a house in freedom from soot or smudge.

The Reduced Rates

now in effect have lessened the cost more than 10 per cent. It may pay you to investigate—to compare the cost of less desirable forms of illumination. A solicitor will call if you desire. Call telephone Main 1280.

Chicago Edison Company
Commonwealth Electric Company
139 Adams Street

is expensive and one of their best advertising productions along this line is reproduced herewith.

Developing a Day Load for a Small Central Station.

At the meeting of the Kansas Gas, Water and Electric Association Mr. C. L. Brown, of Abilene, Kansas, presented a brief paper with the above title, which we reprint below.

The superintendent of a small central station operating in cities of from three thousand to ten thousand population is confronted with the ever present problem of straightening his load curve in a more serious form than the operator of a larger plant, because the larger the city in which a plant is located, the greater are the demands for twenty-four-hour service, and the uses for current are more diversified.

It towns of from five to ten thousand people it has been a question whether or not a twenty-four-hour service could be operated at a profit, especially if the plant had to be run by steam and fuel was expensive. While there has been an urgent demand on the part of a few for day service, the sum of these applications did not seem to warrant the additional investment and expense of operating the plant continuously. In our own case we had been repeatedly urged to furnish a day service by users of gasoline engines, these requests becoming more numerous and urgent in the winter time when the gasoline engine becomes most refractory. However, after thoroughly canvassing the town for the sale of motors we found that our revenue from this source alone was not sufficient at the outset to pay running expenses.

After having started the service, however, we have found new and unexpected uses for the service, and many inquiries have come to us for current unsolicited. Of course during the summer season the fan business is both profitable and satisfactory, as these are now made to operate very economically, and the first cost of installation is reasonable.

The flat-iron business we have also found to be quite a factor in building up our day load. At first we endeavored to sell these irons outright but found customers skeptical and the sales slow. We then decided to put the irons out on 30-days' trial and put one in every residence on our circuit, and at the end of the trial period presented bills for the irons. Over 90 per cent of these irons put out on trial were purchased outright, and have been giving very little trouble in operation.

Cooking devices have also been installed in limited numbers and we believe with a little effort could be quite generally introduced and installed. The greatest difficulty with these devices we have found to be ignorance as to the manner of using the various utensils. Sewing-machine motors, small dental lathes, ventilating outfits, coffee mill motors, etc., each "help some," though the revenue from these is not large.

Another factor in developing a profitable day load is the lighting of cellars and dark passageways and closets. We have, by suggesting the possibilities in this line, induced the owners of a number of dark cellars to clean them up and by properly lighting them they have been put to use, thereby not only furnishing an additional revenue for the lighting company, but also pleasing a customer by enabling him to secure an additional rental from property which was previously of no earning value to him.

The judicious use of advertising and solicitation will develop many uses and much business which was unlooked for and unexpected business. People are anxious to use your current but are ignorant as to the value of the service to them until they have the actual experience in the operation of the various devices; and as the equipment for the use of current usually calls for an expenditure for apparatus on the part of the consumer he is naturally a little timid about making the investment. Constant effort and push will, however, bring their rewards in this as in any other line of business, and the development of a day load we believe lies almost wholly with the central station managers.

A New Soliciting Scheme at Sheboygan.

Previous mention has been made in these columns of the difficulty the Sheboygan Light, Power & Railway Company has had in getting results from ordinary methods of soliciting for new business. As previously noted, after several solicitors had thrown up their hands in despair, Mr. Ernest Gonzenbach, the general manager, hit upon the plan of constituting the heads of departments a kind of "new business" board. Recently another novel scheme has been tried which seems to promise good results. The city is divided into twelve districts. A high school boy is employed as a solicitor in each district. Each solicitor is allowed free street car fare and a commission of $1 on each 10-light electric light customer obtained and five cents additional for each light over ten. The commission on electric flat-irons is fifty cents each. These solicitors receive complaints which are afterwards investigated by the company. One boy turned in enough to get $5 the first day.

Multiple-Rate Systems in Two Indiana Towns.

A central station in an Indiana city of about 5,000 inhabitants has the following multiple-rate system, which is said to work out very well in practice. The rate is based on the amount consumed per 16-cp lamp or equivalent connected per month. For all energy consumed up to 3 kw-hours per 16-cp lamp connected, the charge is 11 cents per kw-hour. For all over 3 and up to 6 kw-hours consumed per 16-cp lamp connected, the charge is 10 cents. From 6 to 9 kw-hours, it is 9 cents; from 9 to 12 kw-

hours, 8 cents; and for all over 12 kw-hours 7 cents. In other words, if a customer has one 16-cp lamp which he burns 53 hours per month, he will have consumed about 3 kw-hours and will pay 11 cents per kw-hour. For energy over and above this he pays 10 cents per kw-hour until he reaches a consumption of 6 kw-hours, and so on. The rate is in proportion for each 16-cp lamp or equivalent connected. The rate is logical because it makes a high rate to cover fixed charges and a low rate after fixed charges have been met. It is not by any means as hard to figure customers' bills as might seem at first sight because the turning points at which the rate per kw-hour changes for each customer can be marked on the customer's meter or ledger account at the office. In a neighboring Indiana city a similar system is in vogue. In this town the rate is 12 cents for all energy less than 2 kw-hours per 16-cp lamp connected. From 2 to 4 kw-hours there is a 10 per cent discount; from 4 to 6 there is a 20 per cent discount; from 6 to 10, 30 per cent; from 10 to 15, 40 per cent; from 15 up, 50 per cent.

An Isolated Plant Advertisement.

The Chicago central station companies, in their campaign to secure business previously done by isolated plants, recently used

Power for Your Factory at Wholesale Price
It is impossible to manufacture power in an isolated plant as cheaply as we can sell it. We sell it at a very small profit for a lower price per actual horse power used than an isolated plant can possibly produce it for — all things considered. It is just the difference between wholesale and retail in the cost of production.
Power From Central Station
runs day time—night time—overtime—and all the time. The risk of breakdowns is reduced to a minimum. You have no fires to feed—no ashes to cart—no gauges to watch — need no skilled engineer. The power starts and stops with the twitch of a switch.
Isolated Plants Expensive
when you stop to figure the investment and depreciation charge. Electrical generating machinery becomes quickly obsolete. Your power plant must either be made much larger than you need or run the risk of being outgrown by increased demands upon it. Central station power is perfectly elastic. May be used as needed — much or little. You pay only for what you get.
Power Test Costs You Nothing
at your plant. Our representative will make it at your request. He may find some valuable facts for your information. Whether or not you decide upon using electrical current from our central station—it will be of interest to know how its cost compares with other methods in your particular case.
Telephone Main 1280
Chicago Edison Company
Commonwealth Electric Company
139 Adams Street

the accompanying advertisement. These companies are, by the way, meeting with remarkably good success in the displacement of isolated plants, especially since the great Fisk Street station has been put in operation and the enforcement of Chicago smoke laws is becoming more strict.

"New Business" Notes from Denver.

Considerable notice has been given in these columns from time to time of the "new business" campaign methods of the Denver Gas & Electric Company, which has the largest "new business" department of any company of its size in the country. As previously outlined, the company divides the city up into districts with a solicitor and an assistant to each district. The district solicitors are paid partly a flat salary and partly a commission based on the estimated earnings from new business secured. A new feature recently added has been that of service supervisors. These service supervisors are assigned the work of looking over existing installations to suggest improvements and adjust complaints and to increase the consumption of present customers whenever possible. These service supervisors, like the other various specialists on the soliciting force, get salaries which are the average of those paid to the district solicitors. The business from each district is credited to the district solicitors without regard to the source from which it comes.

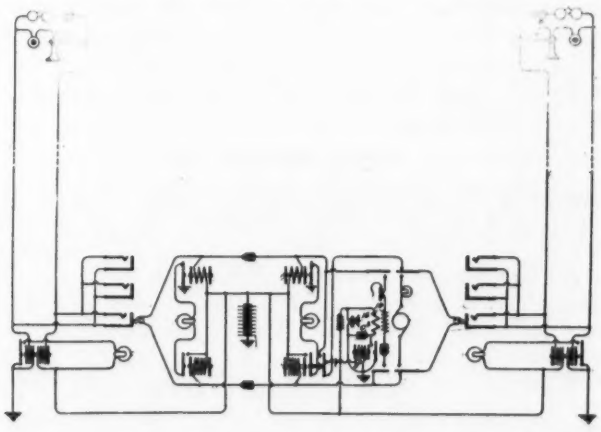
Last year every $1 spent on the "new business" department brought in $3 increase in gross income. This applies to the electric earnings only. The increase in peak load of December, 1905, as compared to December, 1904, was 35 per cent. The load factor remained about the same, being 40 per cent in one case and 42 per cent in the other, indicating that the company has worked long-hour business to an extent where material improvement in the load factor is probably not to be expected. Mr. C. N. Stannard, secretary and contract agent of the company, figures that the natural increase of business without solicitation is about 10 per cent, so that everything above that is credited to the efforts of the new business department.

For about two years there has been in force a plan whereby residence owners wishing to have existing houses wired can do so and pay for the installation by installments. This is applicable to old houses only, and is the outgrowth of an old plan of gas piping. The contracts for residence wiring under this plan are taken by the company's solicitors at a regular rate of $3 per room, which includes the wire and the fixtures, using certain standard plain fixtures which are exhibited at the company's offices. This price does not include the first installation of lamps, which is extra, although the company furnishes lamp renewals free. The contract is carried out by some local wiring contractor. The Denver Gas & Electric Company, however, carries the account and collects from the customer, paying the contractor in cash. About 75 per cent of the houses previously unwired, which are added to the company's list of customers each month, are wired on the installment payment plan.

New Telephone Patents.

COMMON BATTERY CIRCUIT.

The accompanying engraving shows a common battery switchboard circuit patented by W. W. Dean and assigned to the Kellogg Company. The line relay is differentially wound, but the coils are of unequal effect. When a plug is inserted in a jack



DEAN TELEPHONE SYSTEM.

enough extra current is supplied to the weak coil of the relay to balance the strong coil. The limits of operation of the relay are sufficient to allow for sixteen practical line variations.

AUTOMATIC SYSTEMS.

With some of the simpler automatic systems trouble occurs, because the manual restoration of the selector is forgotten by the users. In order to overcome this A. Van Wagenen, of Sioux City, Iowa, has arranged a selector switch such that conversation cannot be held until the switch is set for automatic restore. The switch dial and contact plate are held together by a spring. When the dial moves the contact plate is locked and stays behind. Then the dial locks and the contact plate overtakes it, whereupon the

dial must be returned and locked at zero. After conversation the dial plate unlocks and comes home. An unlocking key and the switchhook together control the locks.

Another invention of Van Wagenen relating to the same sort of system provides a special arrangement of wiring such that all necessary current is supplied from a central source.

SWITCHBOARD CIRCUIT.

Some little time ago attention was called to a consequent pole relay in connection with a four-signal switchboard. The same inventor, W. W. Dean, has now patented a switchboard circuit system depending upon the same device. The consequent pole-relay consists of a closed magnetic core with a coil upon each leg. When the magnetic effect of the coils opposes there is formed between the windings consequent poles. Under all other conditions no pole is formed; or at least it is not formed at the place where the armature is presented. In using this relay for line signalling purposes both coils are included in the line circuit, and the two get the same current. One coil is wound with a high resistance and one with a low resistance, but they have the same number of turns. The consequent pole lamp serves to light the line signal. When the operator responds at the jack she shunts out the high resistance coil of the consequent pole relay and disperses the pole. Mr. Dean has assigned this patent to the Kellogg Company.

Letter to the Editors.

Street Lighting in Mankato, Minn.

To the Editors of Electrical World:

Sirs:—In your first issue of November I see you take up the subject of "Special Lighting of Down-town Streets." We have gone into this subject in our city with good results. We have our streets lighted with eight street arches, made of gas pipe, which span the street and stand 20 ft. high. Each arch has thirty 16-cp lamps, for which we make a flat rate of $25 per month for lighting two nights each week. The city pays for the original construction.

The result we find very beneficial in that the lighting attracts the attention of outsiders who happen to be in the city and also brings the people down town on to the business street on these special nights. Moreover, merchants make special displays in their windows and we thereby dispose of a good deal of current, which would not be demanded if the arches were not illuminated. It also teaches them all to "Get the Habit" and use electricity.

Mankato, Minn. R. E. Brown.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Transformers with Variable Transformation Ratio.—Wikander.—For the proper calculation of the different steps in rheostats for starting direct-current and induction motors, the use of graphical methods is well known. The author shows that such methods should also be used in calculating the different steps of transformers with variable transformation ratio, such as are used in locomotives with series single-phase motors. In all locomotives of this kind built so far the mistake has been made of making all steps equal.—*Elek. Bahnen,* October 4.

Output Coefficient.—Hobart and Ellis.—A continuation of their illustrated serial on the design coefficient for dynamo-electric machines. The authors give a table which shows that the total works cost of a machine does not depend materially upon the output coefficient. The authors then give data which they have collected from numerous direct-current machines for the purpose of finding a relation between dimensions and weights. A diagram gives curves for the total works cost of machines per ton of weight for small and large machines.—Lond. *Elec. Rev.,* November 9.

Lamps and Lighting.

Municipal Arc Lighting.—Davidson.—A paper read before the Empire State Gas & Electric Association. The author mentions some low prices at which contracts have been made in some cities for city arc lighting; thus Little Falls charges $35, Buffalo and Utica, $56—this price being for 450-watt lamps operated 4,000 hours per year. These prices are, of course, below self cost. The author calculates the cost for a typical plant equipped with all modern appliances for economical operation, and of about 1,000 kw capacity, generating two-phase currents for commercial lighting and power and for city lighting. He finds that the cost per lamp per year would be $71.31, so that a fair price to cover profit and a margin in case of accidents, strikes, etc., would be about $85. Attention is called to the fact that a large part of the cost of operating a lamp is in insurance, taxes, interest on investment and maintenance and care of the lamp itself. The item of depreciation is very heavy. With the systems in use in many towns each arc lamp requires the generation of 1 hp by the engines or water wheels at the station, and under ordinary conditions the horse-power for the ordinary mill-operating year of 3,000 hours, costs from $40 to $60 generated in the building. With reference to the low prices mentioned in the beginning of the paper the author says that "it would appear that the officers of these cities, instead of collecting their taxes for lighting from all the people in the city who are benefited by it, have forced through threats of municipal competition, or through threats of other ruinous competition, the companies in question to tax their electric light customers for the city lighting; for if the company is to live the loss met by the company on this city lighting must come out of the company's customers." In the discussion Collins said that price may bear no relation to cost whatever; in Little Falls they have water power and sell electricity at a low price; they make a very low rate for municipal arc lighting, which is no more than one-half of what the actual price should be, in order to get the business. Hartman remarked that "if our municipalities would only take over the city lighting without going into the commercial business we would be very glad to see it done." Cooke suggested the selling of electricity to municipalities on the kw-hour basis rather than on a flat rate. Cole thought that contracts should be made on a maximum and minimum rate basis, the city guaranteeing to use a certain number of kw-hours every year. In his experience as soon as a contract is made on a kw-hour basis the municipality begins to notice during the winter months that bills are running up and they cut out lamps everywhere, and then gradually put them back in the summer months. The contract becomes so erratic on the city's part that there is not much profit in it. Collins mentioned the case of a little village which had always a deficit on the municipal operation of their pumping and lighting plant, but now get a surplus after the work has been taken over by a company.—*Progressive Age,* November 15.

Train Lighting.—Buettner.—When the German State Railways undertook lighting of railway trains the condition was imposed that no system could be used which required movable regulating and switching devices. This condition has now been completely fulfilled. For regulating the varying voltage, iron resistances are used in series with the lamps, so that simultaneously with the lighting the battery may be charged. These iron resistances are constructed in exactly the same way as the ballasts of the Nernst lamp. Rosenberg has devised a machine which always gives current in the same direction whatever the direction of movement of the train and which gives constant power within wide limits of speed. Finally aluminum cells are used to avoid the automatic switch which is required to disconnect the machine from the storage battery when the voltage of the machine drops below that of the battery. and to connect the dynamo to the battery when the voltage of the former has risen to the proper value. The connections are clearly shown in Fig. 1, which needs no explanation. For the aluminum cell

ammonium borate with one aluminum plate and one iron plate is used; these cells have proven perfectly reliable during the four years of commercial service. When a cell has not been used for a long while, and when it is connected so as to cut off the current, it first permits the passage of more or less current, which gradually diminishes. Enough current can pass, however, so that the fuse would blow. To prevent this the cell is first connected for a few minutes with the battery through the resistance, *W*, shown in the illustration. Care must be taken that the aluminum cell is not heated. At temperatures of above 70° it fails. Results are given of tests of aluminum cells.—*Zeit. f. Elektrochemie,* November 2.

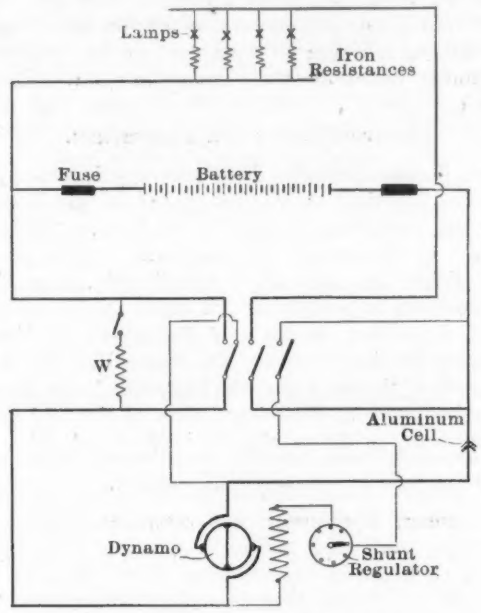


FIG. 1.—TRAIN LIGHTING.

Power.

Electric Power in Factory.—A note on some extensions of electric driving in the works of Vickers, Sons & Maxim. Two steam turbines are now being built to drive a 2,000-kw, three-phase alternator at 1,500 r.p.m. and 650 volts, and the second to drive a 1,000-kw alternator at 1,500 r.p.m. The output of three alternators will be distributed to various centers about the River Don works, where it will be converted into direct current at 220 volts by motor-generators, consisting of 600-hp, three-phase synchronous motors, direct-connected to 400-kw, direct-current machines running at 428 r.p.m. Four of these generators are now practically finished, and others will be added as occasion arises. The three-phase system is not in any way intended to supersede the existing direct-current, 220-volt system, but is an extension of it, necessitated by additions to the workshops of the company; and as some of the additional buildings are at a considerable distance from the power house, the 650-volt pressure secures economy in copper. It is anticipated that, with the large turbine units, the saving in fuel and other charges will be very much greater than the loss of about 15 per cent in the motor-generators.—Lond. *Elec.,* November 2.

Electric Winding Machine.—DAMM.—An illustrated description of the electric winding machine at the mines de Houille de Ligny-les-Aire. The electrical connections are shown in Fig. 2. The current passes from the booster, *Z M,* to the motor, *P M,* of the motor-generator and then returns to the bus-bars. The starting machine, *A M,* is connected in series with *P M,* and to the terminals of these machines the two hoisting motors, *F M,* are connected in series. Normally the starting machine, *A M,* is fully excited, but in an opposite sense to *P M,* so that the voltage at the terminals of the two hoisting motors is zero. The machine, *P M,* remains continuously excited, while when the hoisting motors are started, the starting machine, *A M,* is regulated in such a way that the voltage of the terminals of the two hoisting motors increases from zero to the voltage of the station. Correspondingly the hoisting motors begin to work. The excitation of *A M* is then reversed and again brought up to its full value, so that the voltage at the terminals of the two hoisting motors is now twice the bus-bar voltage. The hoisting motors, *F M,* are now running at full speed. During stopping the reverse process goes on. Starting takes about 12 seconds, stopping 5 seconds. Since the maximum power required by the hoisting motors is 510 hp for 12 seconds, while the central station can give not more than 300 hp for hoisting, a large fly-wheel is used as a load equalizer. It weighs 12,000 kg. and runs with a maximum peripheral speed of 75 meters per second. In order to give off energy its speed must be automatically decreased. This is done by means of the booster, *Z M.* The current from the central station passes through a coil before it comes to the terminals of *Z M.* This coil attracts an armature which actuates the shunt regulator of *Z M* with the aid of a switching mechanism driven by the motor-generator. When the current increases beyond the proper value, the booster is so excited that the central station voltage is diminished by the armature voltage of the booster. *P M,* therefore, runs more slowly and the fly-wheel gives off energy. The maximum variation of voltage by means of the booster is ± 15 per cent of the central station voltage. The system has been found perfectly satisfactory during one year of practical service.—*Glueckauf,* September 15.

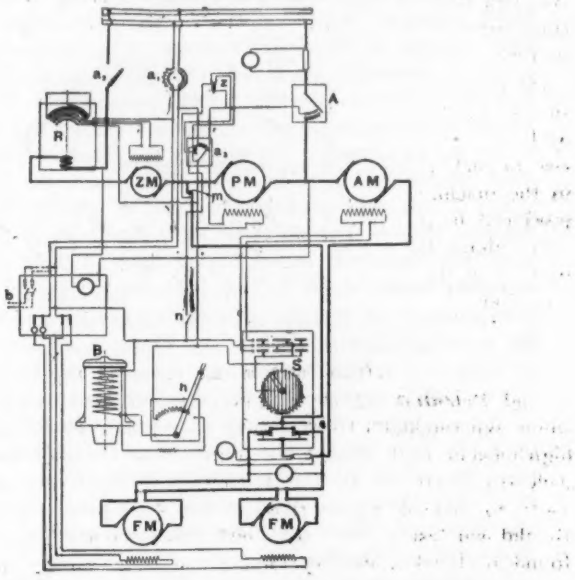


FIG. 2.—ELECTRICAL CONNECTIONS FOR WINDING MACHINE.

Installations, Systems and Appliances.

Static Trouble.—JACKSON.—An article in which the author refers to a peculiar static trouble in case of two 6,600-volt generators delivering power to a transmission line through delta-connected transformers having a ratio of 6,600 to 66,000. It was found that when a ground occurred on one leg of the transmission line static disturbances and breakdown of the insulation occurred on the generators. To explain this trouble one has to consider that the two windings of a transformer act as the two plates of a condenser. If the secondary winding of the transformer is connected to an insulated circuit, such for example as the armature of a generator, then this whole circuit will be subject to an alternating static charge, provided one terminal of the high-tension winding is grounded. Now the generator forms likewise a condenser between its windings and the iron. These two condensers are in series between the high-tension windings and ground. Two condensers in series divide their potential strains inversely as their capacities, and as the capacity of the generator windings to the iron is generally large, the corresponding strain on the insulation may not be great enough to puncture it. In the special case in practice, however, mentioned above, one generator was feeding a bank of large transformers and the capacity of the high and low-tension windings to each other was comparable to that of the generator windings to ground. Of the 66,000 volts across the two condensers somewhere near half could be across that formed by the generator windings and its iron, with a puncture as the result. A step-down transformer on a transmission line will be subject

to strains to its iron and case, but if oil-insulated it is usually better able to withstand them than a generator. The remedy is to ground some point, preferably the neutral, of the low-tension windings. This ground need not be a complete one.—*Elec. Jour.*, November.

110 *Versus* 220 *Volts.*—An article referring to an editorial in the Electrical World on the relative advantages of low and high voltages in three-wire systems. The argument in the editorial is generally approved, though it is thought that the European conditions are not fully understood. In Europe the central station sells electric energy and leaves it to the consumer to buy his own lamps. He will buy the cheapest lamps, whatever their specific consumption. For this reason the new high-efficiency lamps will probably become of greater importance in America than in Europe at an early date. Many European stations may, however, regret having doubled their supply voltage in recent years.—*Jour. f. Gasbel,* November 3.

Ventilation of Electric Stations.—Hartmann.—The losses in the electrical machines in a station appear completely in the form of heat, and if this heat is not removed the temperature may rise to such a degree as to become detrimental to attendants and to the machines. The author shows how to calculate the heat produced in a station and thinks that the increase of temperature above the normal temperature should not be more than 6° C. He gives some data on heat conduction through the walls and floor and roof and then discusses artificial ventilation.—*Elek. Bahnen,* October 13.

Wires, Wiring and Conduits.

High-Potential Cables.—Jona.—The author first describes some experiments recently made at the Milan Exposition with high-tension cables insulated with various layers of different dielectrics, partly vulcanized India rubber, partly paper and sheathed in lead, as described in his St. Louis Congress paper. Breakdown tests were made with three samples and they were found to break down at voltages between 202,000 and 210,000 applied between the conductor and the lead sheathing. This shows a very high rigidity, because the conductor has about 18 mm. diameter, while the total diameter over the insulation is 48 mm., thus giving a total thickness of dielectric of only 15 mm. He then describes some cables constructed for the transmission of 6,000 kw by three-phase currents at 13,000 volts in an Italian system. The cross-section is shown in Fig. 3. The stranded conductor of 75 sq. mm. is sheathed in a lead tube and subsequently insulated by several layers of vulcanized India rubber up to a total thickness of 5.5 mm. Then follows a coating of 1.2 mm. of gutta-percha to insure absolute inperviousness to water. The core is then served with tanned jute and armored with 18 steel wires of 3 mm. diameter. The cable is single-

FIG. 3.—CROSS-SECTION OF CABLE.

cored, three similar cables forming a three-phase line. To avoid the effects of self-induction (fairly considerable in three separated steel-armored cables) each steel wire is wrapped with tarred hemp before being applied. Some experiments were made at the Milan Exposition with an overhead line, the insulators being designed for use on a 60,000-volt line and tested up to 160,000 volts. The voltage was then gradually raised to 200,000 and 280,000 volts. At this potential the hiss of the line was very considerable and there was a bright brush discharge from insulators, line, etc. At 290,000 volts an arc sprang from one of the insulators and set fire to the wooden support. The author finally describes some experiments with a rotary spark-gap.—Lond. *Elec.*, November 9.

Wiring Calculations.—Scheible.—A paper in which the author shows by various numerical examples that there is no need for extreme exactness in making wiring calculations, in view of the uncertainty of the constants used. He thinks that approximate constants and tables should be used more freely for such calculations.—*West. Elec.*, November 15.

Conduit.—An illustrated description of the new English factory for making the type of steel conduit for interior wiring, which is known under the trade name "Simplex."—Lond. *Elec.*, November 9.

Electro-Physics and Magnetism.

Iron in Weak Periodic Magnetic Fields.—Baldwin.—An abstract of a (British) Phys. Soc. paper in which the author examined the induction of iron in weak periodically varying fields, down to extremely low amplitudes. The permeability satisfies a linear law through a considerable range for weak fields, diminishing to a minimum of about 150 as the amplitude of the field diminishes; as the field diminishes the difference in phase between the induction and the magnetizing force tends to disappear, and at the same time the hysteresis losses become very small; the frequency at these low values of the field has practically no influence on the results obtained.—Lond. *Elec.*, November 9.

Heusler Alloys.—Take.—Seven Heusler alloys were examined by magnetometer, dilatometer, and calorimeter methods. One of these alloys, containing 14.9 parts aluminum, 25.2 manganese, 57.8 copper, 1.3 iron and minute traces of lead, showed the finest structure and the highest transformation temperature, lying between 260° C. and 270° C. Beyond the gradual temperatures the alloys assumed a condition of very unstable equilibrium. The ferro-magnetic susceptibility was found to be associated with a slight anomaly in the expansion.—Lond. *Elec.*, November 9.

Electro-Chemistry and Batteries.

Storage Batteries.—Cowper-Coles.—The first part of a paper read before the (London) Society of Engineers, on recent storage battery improvements. After a review of various types of grids, the author speaks at some length of the proper cut-off point of discharge. On Fig. 4 are plotted curves, each of which shows

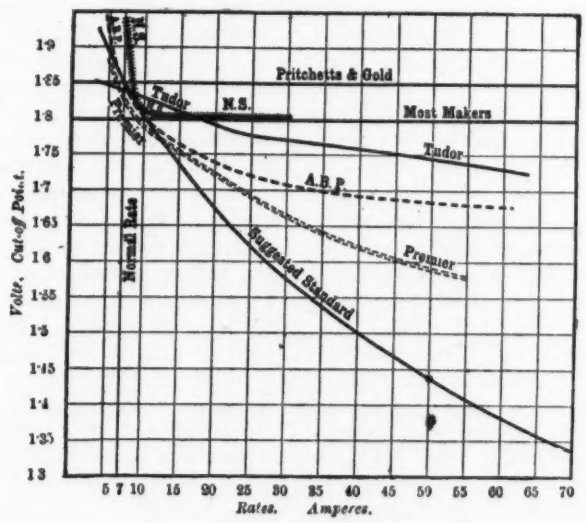


FIG. 4.—CUT-OFF POINTS.

the points at which a given make of cell is stopped at various rates, according to the instructions of the manufacturer. Some manufacturers use the same figure at all rates. In determining the proper cut-off point, two factors should be taken into consideration, namely, first the difference of potential below which the plate is injured at a given rate, and second, the lowest voltage at which the cell can perform the work called for. The author suggests a new cut-off point for different rates of discharge, the curve being shown in the diagram as the "suggested standard." This curve is based on the fact that English manufacturers agree that it does not injure any cell to discharge it at a 10-hour rate down to 1.85 volts. In discharges at other rates—say, for instance, 40 amperes—the author endeavors to determine the point at which the plates would be in "the same chemi-

cal condition" as at the 10-ampere rate at 1.85 volts. For this purpose he occasionally switches back the current to 10 amperes for a short time (about 1 second); the potential difference increases thereby since the ohmic loss is decreased and the polarizing e.m.f. is also decreased. (The author attributes the latter to the extent to which the negative electrode has been temporarily converted into a hydrogen electrode, while in reality concentration differences in the electrolyte probably play a far more important part.) In each case the discharge at any certain rate was stopped when the ammeter needle was at 1.85 volts at the end of the rapid switching movement to the 10-hour rate. The author then discusses defects of negative pasted plates. The paper is to be concluded.—Lond. *Elec.*, November 9.

Metallic Sodium.—CARRIER.—The first part of an article giving a complete review of the different processes which have been suggested and used for the extraction of metallic sodium. After a brief discussion of purely chemical processes, the author describes the electro-thermic process proposed and then passes over to the discussion of the various electrolytic fusion processes. The paper is to be continued.—Lond. *Elec. Rev.*, November 9.

Units, Measurements and Instruments.

Testing Magnetic Metals.—FRAICHET.—An abstract of a paper presented before the recent International Congress for Testing Materials in Brussels. His new method of testing steels may perhaps prove of more scientific value than technical interest. He observes the variation in the magnetic permeability of a test bar while under tension. The bar forms the core of a bobbin composed of a primary circuit of stout wire, joined to two accumulator cells, and a secondary circuit of thin wire joined to a galvanometer. The flux through the test bar varies owing to two causes. The length of the test bar is changing and its cross-section diminishing, which produces a continuous regular vibration in the flux; there will be structural changes in the steel, which result in irregular changes in the permeability. The interpretation of the curves is not easy, however, because the magnetic circuit is completed through the shackles and the frame of the testing machine, and the tightening of the grip considerably affects the magnetic reluctance of the circuit, especially if small magnetizing forces were applied. Low magnetization is, on the other hand, preferable, because the fluctuations in the permeability are more marked at low magnetization. Under these circumstances it is not surprising that the conclusions at which the author had arrived, when first describing his apparatus in 1904, have not all been confirmed by his subsequent researches. The permeability seems to increase at the commencement of the elastic deformation and the magnetic circuit becomes completely closed much sooner than he had first assumed; weak magnetizations are, therefore, recommended; the limit of elasticity corresponds to a rapid deflection of the galvanometer, not to the maximum deflection.—Lond. *Eng'ing*, October 26.

Testing Wattmeters.—TAYLOR.—The first article of an illustrated serial under the title "The Standardizing Laboratory." In the present installment the testing of alternating-current wattmeters and the arrangement of the testing circuit is described, which enables one to compare the meter at low power factors to the standard which is known to be correct at all power factors.—*Elec. Jour.*, November.

Telegraphy, Telephony and Signals.

Wireless Telegraphy with Undamped Electric Oscillations.—POULSEN.—A lecture held before the Berlin Electric Society on a new system of wireless telegraphy, the chief features of which are said to be a much greater possibility of exact tuning, a much smaller disturbing effect from aerial electric discharges and the reduced voltage in the vertical wire. This is accomplished by the use of undamped electric oscillations instead of the damped oscillations always used heretofore in wireless telegraphy. In his well-known experiments on the speaking arc Duddell produced undamped electric oscillations. By connecting a proper inductance and capacity in parallel with a direct-current arc, he was able to transform part of the direct-current into alternating current. The frequency was from 30,000 to 40,000 periods per second, which is, however, too low for application in wireless telegraphy. The main point of the new invention of the present author is that with Duddell's arrangement a much higher frequency may be obtained if the arc is produced in an atmosphere of hydrogen (preferably mixed with a hydro-carbon, so that illuminating gas was found quite satisfactory). This beneficial action of the hydrogen atmosphere (with exclusion of oxygen) is partly due to the cooling effect; indeed, artificially cooled electrodes produced good results. But the effect is not simply

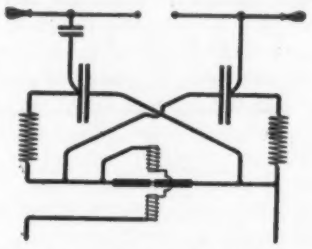


FIG. 5.—WIRELESS TELEGRAPHY.

thermal, but also electrical. Further if the arc is placed in a strong magnetic field, the voltage drop in the arc will generally be very large per unit length of the arc; for instance, 440 volts for an arc length of 3 mm. Under these conditions it is possible to increase the self-induction in the oscillating circuit considerably at the expense of the capacity. This enables one to make the voltage difference at the terminals of the condenser very large. Experience has shown that with the aid of a magnetic field the oscillating circuit may be utilized to a greater extent than without the field. One arrangement shown by the author in his lecture is illustrated in Fig. 5. By using two oscillating circuits with equal frequency in parallel with the arc, double voltage may be produced. The second part of the paper dealt with the applications of these fundamental principles in wireless telegraphy. The characteristic feature of the transmitter is that either a very tight or a very loose method of coupling the oscillating circuits may be used. In tuned wireless telegraphy with damped oscillations a coupling neither too tight nor too loose is preferable, but this is not used with the new system, since the frequency would not be defined with sufficient exactness. In the receiver it is important to utilize as much as possible the resonance principle and to take care that the receiving system contains an oscillating circuit of as small damping as possible, so that it should be coupled as loosely as possible to the vertical wire circuit. On account of the continuity of the waves, the wave detector may be so arranged as to be connected only intermittently with the oscillating circuit. Damping is thereby avoided. The interrupter used for this purpose is called the "tikker"

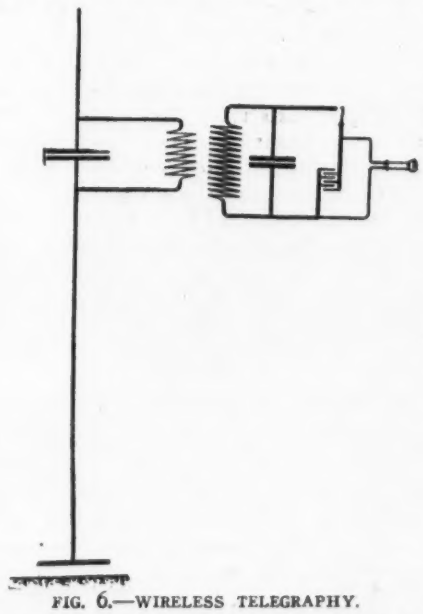


FIG. 6.—WIRELESS TELEGRAPHY.

and the simplest and most effective arrangement of receiving system with ticker and telephone is shown in Fig. 6, which is self-explanatory. The definiteness of tuning is given as 1 per cent; i. e., two stations may communicate with each other with waves of 600 meters length and two other stations at the same time over the same field with waves of 606 meters length and no interference will result. Wave lengths between 300 to 3,000 meters may be used so that several hundred stations may cover the same district without interference.—*Elek. Zeit.*, November 8.

Miscellaneous.

Lightning Conductors.—A discussion, illustrated by diagrams, of the proper construction of lightning conductors. Two different kinds of lightning discharges should be distinguished, first, the steady strain gradually increasing and ending in disruptive discharge, and second, impulse rushes without any previous symptoms. No system of lightning conductors, as generally designed, will be sufficient to protect a building absolutely against a discharge of the second kind, but in many actual cases the ordinary lightning conductor has partially fulfilled its purpose by carrying off the more violent portion of the discharge. In the case of gunpowder magazines, it becomes necessary to enclose the whole structure in a system of wirework, connecting this outer cage to earth at several points. In deciding how far to go in the protection of ordinary buildings, the value of the building, the reduction of the insurance, and the regard for possible loss of life must be considered. If protection is desirable and heavy expense is not justified, then two or three rods might be erected and interconnected horizontally. The metal portions of the roof and the rain water down-pipes should be metallically connected and well earthed. In the case of a chimney shaft, a circular band should encircle the top of the chimney and four or five elevation rods should be arched in and joined together with central points for silent discharge. From the circular band one—or better still, two—conductors should drop to earth. Churches and similar buildings with towers and spires should have the lower projections protected by rods as well as the higher ones. Reverting to the absolute or bird-cage form of protection, modern hotels and office blocks are so frequently built round a steel carcass that one would naturally expect to find in this design a thorough defense against lightning. It is recommended, however, that in this case the feet of all metal columns should be earthed instead of being partly insulated in stone block.—Lond. *Elec. Times*, October 4.

BOOK REVIEWS.

Practical Laws and Data on the Condensation of Steam in Covered and Bare Pipes. By Charles P. Paulding, M. E. New York. D. Van Nostrand Co. 102 pages, 36 illustrations. Price, $2.00.

The object of this volume is to bring to the attention of steam users and engineers a consistent method of calculating the loss of heat from bare steam pipes and exposed boilers. Working engineers are well aware of the great loss from this source, as it is constantly impressed upon them in daily practice; but steam users and manufacturers are not. Proof of this is found in the many square feet of exposed radiating surface that are found in hundreds of steam plants, the loss from which is enormous, as shown by the reports of tests made to determine this point, published in this book. Due consideration of these results, and action that is consistent with the knowledge so gained, will prove to be a profitable investment; hence the book is recommended to all who are interested in steam engineering.

Briquettes and Patent Fuel, Their Manufacture and Machinery Connected Therewith. By Philip R. Bjorling. London, Rebman, Limited. 254 pages; 121 illustrations.

This volume contains a complete description of the process of preparing coal to be manufactured into bricks or briquettes, and also illustrations of many machines used in crushing, drying, mixing and pressing the materials used in patent fuels of various kinds. The subject of bonding the small particles of fuel into compact masses of reasonable size, so that the percentage of breakage in handling will be reduced as low as possible, is treated in detail. The value of briquettes for making steam and other purposes is clearly stated in the form of tables giving the results of carefully conducted tests to determine this point, which is of vital importance.

As patent fuels are composed largely of materials that are cheap because they are in forms which are not accepted as first-class, rather than on account of lack of heating value, any project that encourages the utilization of such materials is of special importance to manufacturers; hence this volume is worthy of careful perusal.

Business Telegraph Code. Chicago: The Business Code Company. 304 pages. Price, $7.50.

That a telegraph code comprising ten times the number of phrases and numerals given in the bulky octavo volumes of the several standard code books in present use can be brought within the compass of a book of pocket size containing only 304 pages, is quite remarkable. This accomplishment implies a radical innovation in the compilation of such codes, and in the case of the book under review this appears to have been done not only without any sacrifice, but with many attending advantages. The system is based upon the use of root and terminal code words, the former of five letters and the latter of four letters. All code words thus consist of nine letters arranged to form pronounceable syllables. This system not only conduces to great flexibility, but admits of the condensation which has led to the production of a code book of pocket size even more complete than the bulky volumes heretofore in use. The method of roots and terminals used enables, for example, all the numerals up to 999,000 to be covered in six small pages. Similarly, brief tables cover the day of each month and phrases relating thereto, days and the hours and half hours of each day, fractions in 64ths of an inch, percentages, etc. The list of phrases embraces the entire field of commercial telegraphing, for buying, selling, prices, orders, quotations, propositions, contracts, shipping, delivery, financial matters, drawings, specifications, correspondence, erecting, insurance, railroads, steamer lines, etc.

An interesting feature of the book consists of two tables covering five pages, by means of which words mutilated in transmission can be traced. Owing to the plan and the comparatively small number of code words in this system of cipher, this method enables mutilations to be in most cases easily corrected, thus avoiding the delays incident to repetition. Another important feature is that all code words are so constructed as to reduce to a minimum the probability of mistakes by telegraphers; that is to say, consecutive letters in all code words are such that when represented in the Morse telegraph signals there is the least chance of mistakes by the receiving operator.

Perhaps one of the most striking characteristics of the code is that its plan is such that it will serve as a basis for private codes. The special requirements of any branch of business can be met by a supplementary code which may be bound in with the general code, thus furnishing under one cover a more complete private code than would otherwise be practicable. The publishers state that they will undertake to prepare such supplementary codes for any line of business. The practical character of the code is vouched for by the experience of the compiler, Mr. Burcham Harding, who has made a specialty of this class of work, and prior to the design of the present system prepared private codes for several of the largest manufacturing companies in this country. The book is printed on linen paper from type carefully selected with respect to legibility.

Electro-Technical Series. By Edwin J. Houston, Ph.D., and A. E. Kennelly, Sc.D. 10 volumes. New York: McGraw Publishing Company. Price per volume, $1.00.

An edition revised to date has appeared of this excellent series, which consists of 10 volumes treating in non-technical language the more important branches of applied electrical science. While the volumes are intended more particularly for the information of the general public, they are also well adapted for electrical readers who wish to obtain an intelligent idea of branches of the industry other than that with which their work is connected. The books are vastly superior to the usual popular electrical book in that the information is absolutely correct, and in the treatment a proper perspective is maintained, the homelier side of an art not being sacrificed to its more picturesque aspects.

The volume on "Arc Lighting" (third edition) now contains 445 pages and 175 illustrations. Among the new matter in the

present edition is a chapter covering photography by the arc light and another on the mercury vapor arc lamp.

"Electric Incandescent Lighting" (third edition) comprises 514 pages and 164 illustrations. New chapters treat of the Nernst lamp, vacuum tube lighting, photometry of incandescent lamps, lighting of railroad trains and the osmium and tantalum lamps.

"Electric Heating" (second edition), 298 pages, 89 illustrations, has a new chapter on the electrical thawing of frozen water pipes.

"The Electric Telephone" (second edition), 453 pages, 152 illustrations, has a chapter added on loaded telephone lines describing the Pupin system of compensating for capacity effect by the introduction in circuit of inductances.

"Electric Street Railways" (second edition), 373 pages, 162 illustrations, is lengthened by a chapter describing the New York Central electric locomotive.

"Magnetism" (second edition), 314 pages, 97 illustrations, has an interesting chapter on the new magnetic alloys.

"Electric Telegraph" (second edition), 480 pages, 172 illustrations, has been extended by a chapter treating of wireless telegraphy.

"Alternating Electric Currents" (fourth edition), 360 pages, 114 illustrations, contains the largest amount of new matter, chapters having been added on turbine alternators, alternating-current traction motors, alternating-current switches and switchboard devices, and constant-current transformers.

"Electricity in Electro-Therapeutics" (third edition), 468 pages, 147 illustrations, contains among new matter a chapter on radium and radioactivity.

DESIGNS FOR SMALL DYNAMOS AND MOTORS. By C. P. Poole. New York: McGraw Publishing Company. 186 pages; 231 illustrations. Price, $2.

The twenty-two chapters of this book contain complete instructions and detail drawings for the construction of as many pieces of electrical apparatus. Designs are given ranging from a 1/16-hp motor to a 75-light incandescent lighting dynamo in direct-current machines and from ¼ to 2 hp in induction motors. There are in addition designs for two electro-plating dynamos, a single-phase rectifier, and a 1-kw, a 2-kw and a 4-kw combined alternating and direct-current machine. Many of the chapters were published in the book entitled "Electrical Designs," while others have never appeared before in book form. All of the direct-current designs previously published have been revised in accordance with the changes in practice in dynamo and motor design which have occurred since their first publication. For the class of readers to whom a work of this kind would appeal, the book is all that could be desired.

MANAGEMENT OF ELECTRICAL MACHINERY. By F. B. Crocker and Schuyler S. Wheeler. New York: D. Van Nostrand Company. 223 pages; 131 illustrations. Price, $1.

This is the sixth edition of "Practical Management of Dynamos and Motors." The work has been extensively revised and has been enlarged by the addition of matter relating to the management of alternating-current generators and motors as well as that of railway motors. Part III, on the "Location and Remedy of Troubles," was published in the *American Electrician* last year. Nearly all of the additional matter could have been treated more thoroughly. The troubles and remedies for direct-current machinery are covered quite fully, whereas the same is far from true for alternating-current machinery, and since the use of the latter class of machinery is increasing rapidly, additional information on this subject would be welcome. The chapter on the "Management of Railway Motors" is far too short; the subject cannot be covered in so few words. As a whole, however, the book must prove very acceptable to those concerned in the practical operation of electrical machinery.

BOOKS RECEIVED.

UNIVERSAL DICTIONARY OF MECHANICAL DRAWING. By George H. Hollows. New York: The Engineering News Publishing Company. 60 pages, 45 illustrations. Price, $1.00.

REINFORCED CONCRETE. Part I: Methods of Calculation. By Albert W. Buel. Part II: Representative Structures. Part III: Methods of Construction. By Charles S. Hill. Second Edition. New York: The Engineering News Publishing Company. 499 pages, 80 illustrations. Price, $5.00.

Motor-Driven Machine Tools in Railroad Shops.

The operation of machine tools by electric motors has an exceedingly wide field, but no class of manufacturing establishments exemplifies the adaptability of electric drive more than railroad shops. The large work handled necessitates extensive buildings and the use of great lengths of shafting and belting if power is transmitted mechanically from a central source. Rush repair jobs are frequent and require a great deal of overtime and Sunday work, when power requirements are small as only sufficient machinery is operated to complete the particular work at hand. Mechanical transmission of power under such conditions is wasteful in the extreme, owing to the surplus power required to overcome the friction of shafting and belting throughout the shops. Where electric drive is used—either individual or group—a flexibility is obtained that cannot be secured by any other means, as it permits the use of a few machines independently, obviating the objectionable features enumerated and permitting operation with a minimum power house capacity,

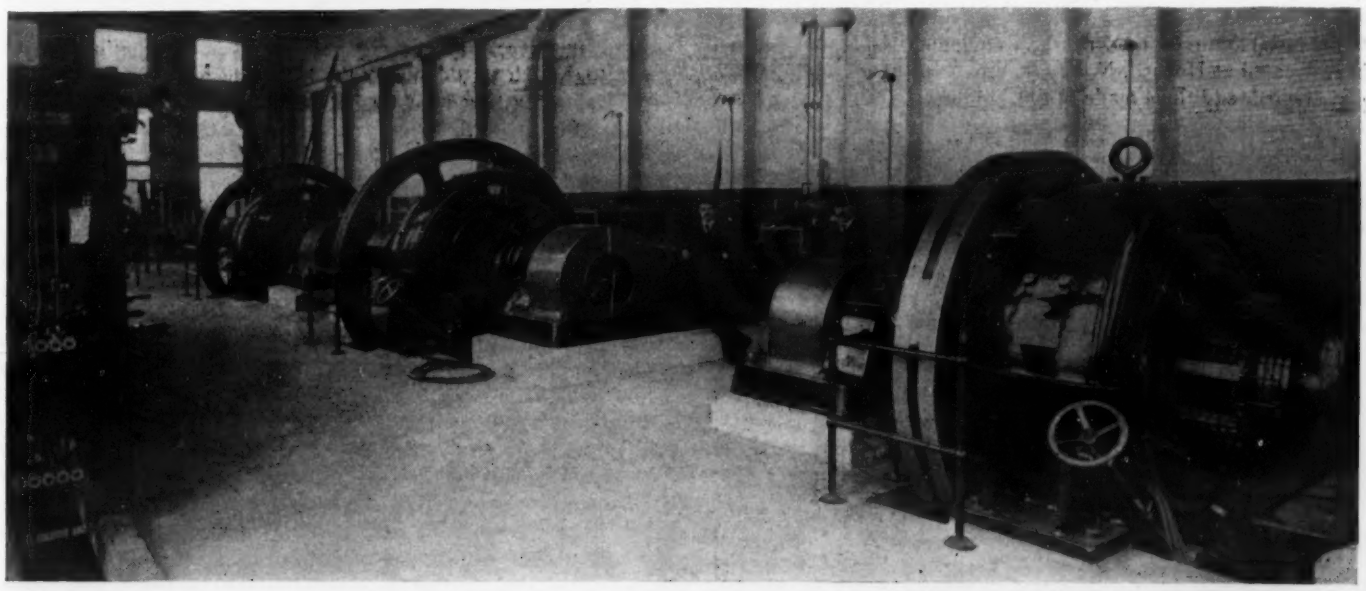


FIG. 1.—INTERIOR OF POWER HOUSE OF THE ERIE RAILROAD SHOPS AT HORNELL, N. Y.

thereby effecting a considerable saving in the quantity of fuel used.

There are many other considerations in connection with power transmission, one of the most prominent being the layout of the plant, which is especially important in a railroad shop as it is generally made up of a number of separate buildings aside from the main machine and erecting shop, which are necessarily scattered, widely distributing the power requirements and necessitating the use of numerous prime-movers. Where engines are used steam is supplied either from a central boiler plant or by individual boilers forming a combination unit with the engine. The former arrangement is exceedingly poor from an economical standpoint owing to the low efficiency resulting from the usual excessive condensation which takes place in long lengths of steam pipe. Either method involves the expense of skilled attendants, which amounts to a considerable sum annually. These conditions are, however, rapidly changing; electric motors are superseding steam equipments and have many times proved that they fill all requirements—reducing operating expenses, requiring a very small amount of attention, providing power that is perfectly reliable, and reducing the time of starting and stopping and of changing the speed to a minimum.

Other applications may be found in cranes and in transfer and turn-tables where the electric motor is superior to every other motive power, owing to its ease of control, efficiency and reliability.

It was these considerations that led the Erie Railroad Company to abandon mechanical transmission of power and adopt the electric drive at its Hornell shops. These shops now utilize electric power entirely and furnish an excellent example of the expediency and use of both individual and group drive.

When the present management took charge of the Erie Railroad it adopted broad and comprehensive plans for the development of the entire property, embracing extensive alterations and additions to the many shops of the system in order to enable them to respond rapidly and efficiently to the increasing demands made upon them by the necessary additions to the rolling equipment.

New shop buildings and round houses have been constructed, old machines replaced by new, an efficient shop organization effected and the entire mechanical department brought up to a high standard of efficiency. This work under the direction of Mr. E. A. Williams, general mechanical superintendent, and Mr. G. W. Wilden, mechanical superintendent, has been carried on at many different points on the system, but the most extensive single installation of modern shop equipment is at the Hornell shops located at Hornell, N. Y. At this point new buildings have been erected, additions made to old buildings, a new power house erected and a large number of new machine tools, with a com-

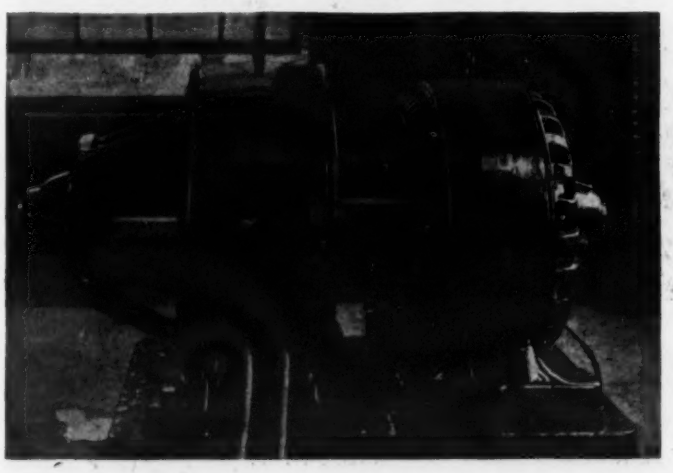


FIG. 2.—MOTOR-GENERATOR SET FOR YARD AND DEPOT LIGHTING.

plete system of electric drive, installed. This installation furnishes an interesting and instructive illustration of the latest engineering practice for a railway shop where the largest proportion of power is required at short distances from the power house and a large proportion of variable speed and crane load is required.

Before making a final decision as to the type of electrical apparatus to be installed a careful comparison was made relative to the advantages and disadvantages of both the alternating current and direct-current types of apparatus for the service contemplated. This analysis included not only the motors themselves, but also the various accessories, such as wiring, controllers, etc.

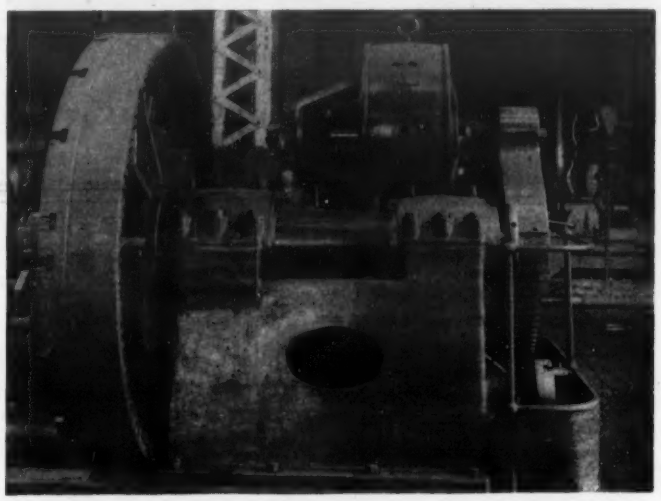


FIG. 3.—DRIVE WHEEL LATHE OPERATED BY A 40-HP MOTOR.

Due consideration was also given to an installation involving the use of both alternating and direct-current motors, but while it appeared probable that at some time in the future an equipment of this nature would be necessary, it was decided that present conditions do not justify the installation of both types of motors. Under the conditions existing at Hornell it is apparent that all of the motors are located well within the limits of 220 volts distribution, and in addition that there is at this time no woodworking shop in existence; therefore, it was finally resolved to make the installation consist entirely of direct-current apparatus with the exception of a small generator set which is used to supply the current necessary for the present yard and depot lamps.

As indicated above, the enlargement of the power house at some future time has not only been contemplated, but provided for. The type of apparatus to be placed in the engine room, however, will be determined upon at the time of making the addition, as the present system can readily be expanded in either of two ways. Additional power can be obtained by the installation of the necessary capacity, either in an alternating-current generator which would supply the lines direct, the present motor-generator set acting as a tie between the present units and the future one, or a direct-current generator, with the necessary transforming apparatus for alternating current, can be installed if it is found that conditions demand that this be done.

The power house is a brick structure of fire-proof construction, with concrete roof and flooring, and has ample provision for light and ventilation. The building is large enough to provide for future extensions, foundations already being in place for doubling the boiler capacity so that it is only necessary to erect the additional units. The interior of the power house is illustrated in Fig. 1, which shows the engines and generators. The boiler plant consists of four 400-hp Babcock & Wilcox units, operating at 150 lb. pressure and equipped with chain grates. All live steam mains are provided with the Holley drip system. The coal-handling and stoking is especially interesting as, from the time the coal is dumped from the cars until it is fed into the furnace, it is conveyed automatically. The coal passes from the car into a chute which empties into a crusher, and is then conveyed by an endless belt to the top of the power house, where it passes through another chute to the second conveyor that distributes it in the bunkers over the boiler room. From there the coal passes through chutes to hoppers in front of the furnaces, where it is fed into the chain grates. The amount of coal admitted into the hoppers is controlled in the boiler room by means of levers. The conveyors, which were manufactured by the Exeter Machine Company, have a capacity of 60 tons per hour and are operated by a 10-hp and a 13.5-hp motor. The coal crusher is operated by a 20-hp motor.

The generating equipment consists of three Ball & Wood cross-compound, high-speed condensing engines, two of 500-hp each,

direct-connected to a Westinghouse 300-kw, direct-current, 250-volt, three-wire generator running at 150 r.p.m., and one of 400 hp direct-connected to a similar generator of 200 kw capacity operating at 200 r.p.m. The engines run condensing except in cold weather, when the exhaust steam is utilized in heating the shops. Water for condensing purposes is stored in a large well, which derives its supply from a small river near the power house.

In addition to the generating equipment and pumps there are two Ingersoll-Sargent compound air compressors that furnish compressed air to the pneumatic hammers in the shops.

Fig. 2 illustrates a motor-generator set which supplies current for the yard and depot lamps. It consists of a 115-hp, direct-current motor, direct-connected to a 75-kw, two-phase, 60-cycle, 1,040-volt, revolving-field alternator operating at 900 r.p.m.

The station switchboard is provided with motor-generator panels, direct-current generator panels, feeder panels and a load panel, together with two blank panels providing for future extensions.

Current is transmitted by cables through a large tunnel to the new erecting shop and thence through underground conduits to the various buildings. The three-wire system of distribution is used for lamps and motors, with an electromotive force of 250 volts between outside wires and 125 volts between each outside wire and the neutral. There is a decided advantage in the flexibility of the voltage, as incandescent and Cooper Hewitt lamps are operated on the 125-volt sides of the system and constant-speed, 250-volt motors are connected to the main or outside wires while the variable-speed motors utilize shunt field control.

The old erecting shop utilizes both group and individual drive, the group-driven machines being divided into five sections and operated by five constant-speed motors, two of 30 hp capacity and three of 50 hp capacity. The machines in the fitting shop, which occupies one wing of the erecting shop, are also group-driven by a 30-hp, constant-speed motor.

In addition to the group-driven machines in the erecting shop there are a number of individually-driven machines operated by both constant and variable-speed motors. There are the following constant-speed motor-driven machines: One 20-hp motor driving a planer; one 13-hp motor direct-connected to a 600-ton wheel press, and one 7.5-hp motor for moving a tail-stock of a driving wheel lathe. There are also the following variable-speed, motor-driven machines: One 7.5-hp motor operating a vertical miller for side rods; one 20-hp and one 6-hp motor operating a 90-in. boring mill; one 20-hp motor operating a driving axle lathe; one 7.5-hp motor operating a driving axle lathe; one 7.5-hp motor operating a crank pin lathe; one 40-hp motor operating a 90-in. driving wheel lathe, and one 25-hp motor driving a truck tire lathe.

The list of variable-speed motors and the machines they drive is a typical illustration of the class of applications that have demonstrated their ability to increase the output, as the time and labor necessary to shift belts or change mechanical speed devices is minimized, and a piece of work can be machined continuously from the smallest to the largest diameter without interruption. The speed of these motors is controlled by varying the field strength, and, as this may be done while the machine is in operation, it affords an easy and convenient method of speed regulation always under the immediate control of the operator, the controller being conveniently placed within his reach.

One of the most prominent characteristics of this method of control is the simplicity and low cost of control apparatus made possible by the extremely small current which is handled. A second marked characteristic is the increase of speed with decrease of torque, when used as an adjustable speed motor, the horse-power output remaining practically constant throughout the whole speed range, which makes it peculiarly adapted to machine tool driving. This system involves the use of a minimum amount of auxiliary apparatus, thus materially reducing the first cost of an installation. The regulation of motors operating by shunt field control is good, which is of special importance in the operation of machine tools and in service of any class where constant speed is desirable and where the torque varies between wide limits. The efficiency of motors operating at variable speeds remains practically constant over the range of speed.

Having considered the erecting shop equipment, the smaller shops next receive attention. The machine tools in each department are arranged in a group and driven by a single constant-speed motor. In the tool room there is a 20-hp motor. In the carpenter shop a 50-hp motor, in the blacksmith shop a 30-hp

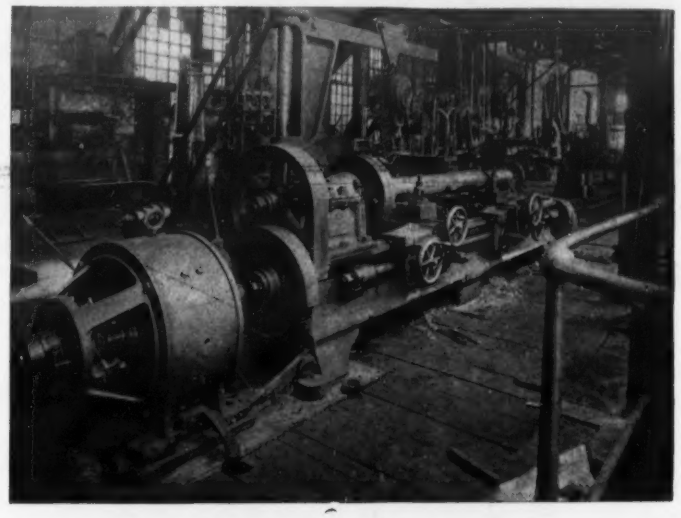


FIG. 4.—LATHE GEARED TO A 20-HP MOTOR.

motor, and in the boiler shop a 7.5-hp motor. Moreover, there are the following direct-driven machines operated by constant-speed motors: One 7.5-hp motor driving a 20-in. punch and shears, one 25-hp motor operating plate rolls, one 10-hp motor operating a horizontal punch, one 7.5-hp motor driving bevel shears, and one 10-hp motor operating a 36-in. punch and shears.

In connection with the boiler shop equipment there is a flue rattler which is located outside the building and is operated by a 20-hp motor. In the tank shop there is a 20-hp motor, a 15-hp motor and a 10-hp motor. In the round house machine shop there is a 20-hp motor. There are also the following miscellaneous applications: One 70-hp motor driving a fan for the round house heating system, one 10-hp motor driving a fan for the new erecting shop heating system, one 7.5-hp variable-speed motor operating the round house turn-table, one 50-hp, constant-speed motor operating the coal conveyor in the locomotive coaling station, one 30-hp, constant-speed motor operating the conveyor for removing the ashes from the locomotive ash-pit; one 7.5-hp motor operating alligator shears for cutting up sheet scrap, and one 25-hp motor operating the transfer table.

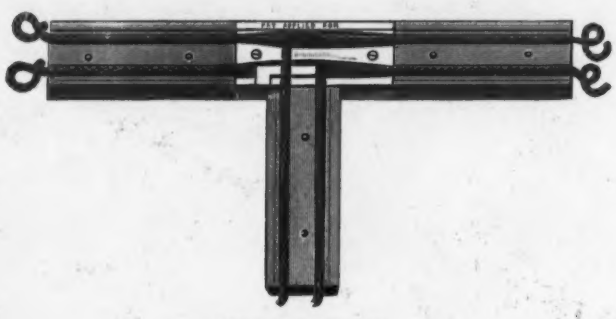
The preliminary studies and final report, showing the benefits which would be the result of electrically equipping these shops, were made by the Westinghouse Electric & Manufacturing Company in conjunction with the motive power department of the Erie Railroad. The results have more than borne out the promises made to the management.

FIG. 5.—HORIZONTAL PUNCH DRIVEN BY A 10-HP MOTOR.

The installation of the new electrical equipment presented many engineering problems, but the work of transformation was carried on without any interruption to the service, and it reflects great credit to the contractors, Westinghouse, Church, Kerr & Co., who installed the plant, and Mr. George T. Depue, master mechanic of the Erie Railroad Company, who has charge of the Hornell shops. All of these motors, generators and switchboards are of standard Westinghouse make.

Splice Protector.

In order to provide a ready means of complying with all of the requirements of the National Electric Code, and also to afford a better means to neat and safe moulding work than has heretofore been available, a new device for use wherever it is desired to make a branch or tap in a moulding line has been



SPLICE PROTECTOR.

placed on the markt by Jordan Bros., 74 Beekman Street, New York City. The illustration shows the application of the device.

As will be seen, the splice protector assures a solid, substantial soldered and insulated splice, and it also provides a fire and water-proof porcelain protection at the point where the insulation resistance of the rubber covering on the wire is impaired by splicing. It is held in position by the capping of the moulding and is practically invisible; no whittling of moulding or capping is necessary, there are no exposed wires at the point where the splice is made and no chance of capping is necessary, nails being driven through the splice. Moreover, its use makes all work uniform, one branch being an exact duplicate of others. The splice protector is made for two or three wire branches or any combination thereof.

Universal Cable Grip.

The accompanying illustrations show three forms of cable grip brought out by the Universal Cable Grip Company, of Syracuse, N. Y., by means of which cable may be drawn without the lead sheathing being cut, as is usually the case. The grip shown in Fig. 1 slips over the end of the cable, wires or conductors to be

FIG. 1.—SINGLE-EYE CABLE GRIP.

pulled and on the first strain settles tightly about the cable and will not slip off until the strain is released from the base. Most engineers will at once appreciate the enormous strain upon the grip which holds on with such tenacity that either the rope or the cable will have to give way before a failure in drawing can occur, as on account of the construction of the grip the greater the pull the more securely it holds.

Fig. 2 shows the double-eye cable grip, the application of which

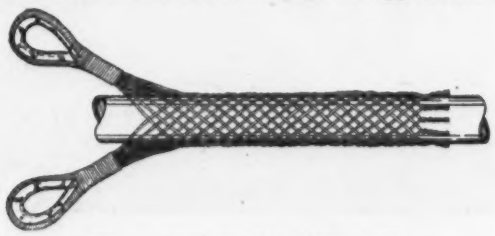


FIG. 2.—DOUBLE-EYE CABLE GRIP

is the same as that shown in Fig. 1, except that it is used for the pulling of slack at any point where slack is desired; either at pole ends, manholes or hand holes. The simplicity of operation is such that no matter how congested or restricted the space, by merely pushing on the grip and holding the strain on the eyes, enough slack may be taken up for any purpose desired. The double-eye cable does away with the old-fashioned method of attaching a marlin hitch to the cable with which to pull the slack.

Fig. 3 shows the double-eye split cable grip which may be applied at any point on the cable, without cutting the cable. The grip is merely placed around the cable, one side being left open for that purpose, and it is then held in place by a rawhide lace. The grips are made in four sizes: 1 in., 1½ in., 2 in. and 2½ in. in diameter. These take cable ranging in size from ¾ to 1¼ in., 1½ in. to 1¾ in., 1½ in. to 2½ in. and 2 to 3 in., respectively.

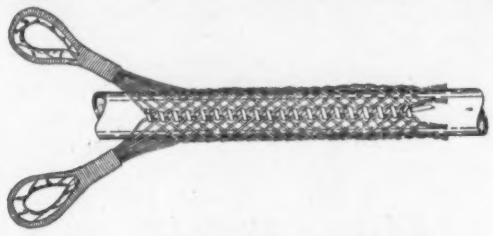


FIG. 3.—DOUBLE-EYE SPLIT CABLE GRIP.

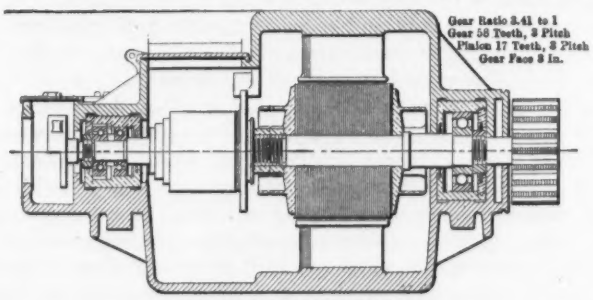
It has been demonstrated in practice that the grips can handle the most delicate outer insulation and covering of a cable without marring, kinking or endangering the same, and that cable broken at the mouth of the duct can be easily pulled out by slipping on this attachment.

Allis-Chalmers Plant in Chili.

Mr. W. F. Hynes, engineer of the Allis-Chalmers Company, has just returned to the United States from Chili, where he installed an Allis-Chalmers equipment of machinery in the copper smelting and converting plant of the Sociedad Industrial de Atacama at Caldero, which handles 300 tons of copper ore per day. The works are situated on the edge of the great Atacama Desert, where the water supply is limited and the quality so poor that the use of steam boilers was impracticable, and the plant installed is entirely gas-driven. It consists of a 400-hp Nuremberg gas engine direct-connected to a 200-kw Bullock direct-current generator delivering 240 volts at 150 r.p.m. The current is used for lighting, high-voltage lamps being installed, and for driving about 20 motors ranging from 10 to 65 hp. There is also an Allis-Chalmers gas-driven air compressor for the Bessemer converter plant, consisting of a duplex gas-driven air compressor of approximately 300 hp at 90 r.p.m. The gas producer is the R. D. Wood type, using bituminous coal.

Dynamo Ball Bearing.

The accompanying illustration shows the Hess-Bright ball bearing applied to a car lighting dynamo. It will be noted that a larger bearing is employed next to the pinion, where the load is the greatest. At the commutator end the bearing has to sustain only a portion of the weight of the armature and very little of the pinion tooth reaction, and consequently a much smaller bearing suffices. There are two bearings at this end, the inner one carrying the weight and the outer one being simply arranged to take whatever thrust in either direction there may be due



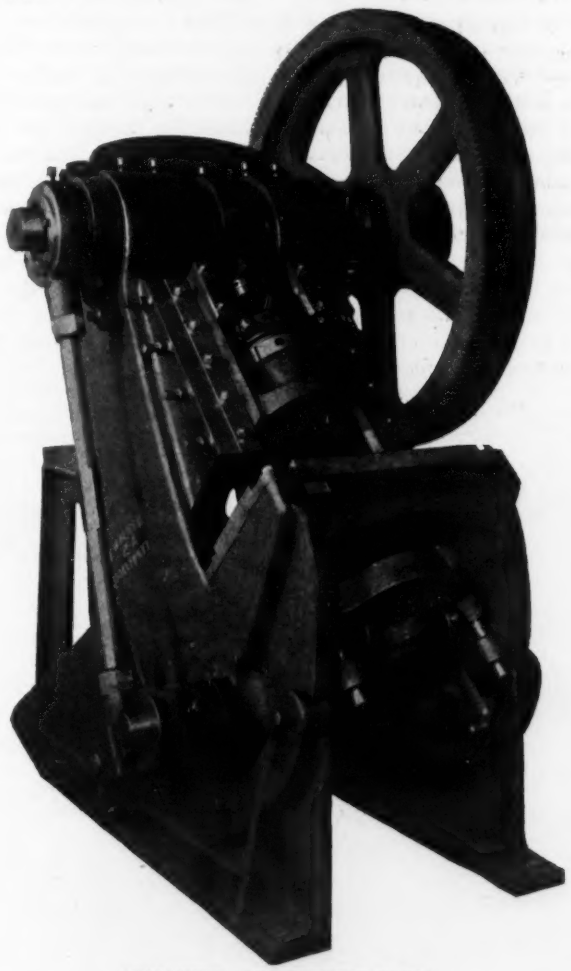
DYNAMO BALL BEARING.

to the pitching or rolling of a car in mounting curves, etc. To insure this bearing receiving only such thrust load and no radial load, it is mounted to be free circumferentially. It was considered preferable to mount the bearings in this case in separate bushings, as the severe pounding incident to the location of the outer mechanism under the car might be too great for the material of the motor frame were the hard bearings to rest directly on that.

This arrangement permitted somewhat more convenient shop-work in providing end closures that prevent leakage of lubricant from the bearing to the armature space or outward end, and which also prevent the entrance of dust, road grit, etc., into the bearings. These closures are very simple devices requiring no packing of any kind and consist merely of two concentric lifts bored out not to exceed 1/64 inch in diameter larger than the shaft and separated therefrom by an annular groove which latter communicates with the interior oil space of the bearing at its lowest point by one or more small holes, as shown. In the particular machine shown the gear ratio is 3.41 to 1; gear face, 3 in.; 58 gear teeth, 3 pitch; 17 pinion teeth, 3 pitch. The bearings are made by the Hess-Bright Manufacturing Company, Nineteenth and Hamilton Streets, Philadelphia.

Armature Disk Cutting Press.

The large demand for armature disks for motors and dynamos has brought about many improvements in the presses used for manufacturing them. This is perhaps more noticeable in the machines that have been designed for cutting disks complete with the notches and center hole. Disks made in this manner are more usually for the standard types of motors of which there is the greatest demand and naturally in which there is the keenest competition. It is therefore essential that these disks be produced in the most economical manner and with a minimum of handling. To accomplish this the E. W. Bliss Co., 12 Adams Street, Brooklyn, N. Y., has built a special press, shown in the illustration herewith.



ARMATURE DISC-CUTTING PRESS.

The machine has been designed along entirely new lines and the special features embodied in it are interesting. To do away with springs which absorbs a great deal of the energy of the press, as well as being unreliable, this new machine is fitted with positive knockouts for both the punch and the die. The slide is very long and accurately fitted to give perfect guidance to the delicate dies which are to be operated in the press and it is connected with the shaft by two solid pitmans which evenly distribute the load. There is a special adjustment in the mandrel so as to accommodate various heights of dies. The upper knockout is stationary and is between the two pitmans. It acts positively against the knockout plate in the mandrel which in turn acts against the knockout pins in the die (holes for these pins are shown in the mandrel). This knockout has screw adjustment to compensate for any adjustment that may be made in the mandrel.

The lower knockout is actuated by an eccentric cam on the shaft which gives motion to the knockout levers by means of a long connecting rod which also serves to adjust the travel of the knockout plate. The knockout levers are fastened to the lower shaft and raise the knockout plate on the up-stroke of the slide. The plate is accurately guided by two rods to keep it perfectly level so as to have a uniform pressure upon the knockout pins in the lower die.

To eliminate the handling of the punched disk the press is set on an incline and as soon as the piece has been discharged from the die it falls through the back of the press while the upper knockout frees the scrap from the punch and enables the operator to proceed rapidly to make another disk.

The total weight of the press is about 5,000 lbs., and it is adapted for cutting disks complete with outside notches, center hole and key slot up to 10½ in. in diameter, or it will cut plain disks with center hole up to 12 in. in diameter up to No. 23 Stubs gauge. The press is direct driven by an electric motor, the motor table being shown at the back of the illustration.

Electric Power in Mining in Mexico.

In El Oro and Guanajuato, Mexico, the Westinghouse Electric & Manufacturing Company, through its agents, Messrs. G. & O. Braniff & Co., has installed over 10,000 hp of electrical machinery all of which is driven from a water power source. The cost of this power is from one-half to two-thirds cheaper than the corresponding power by use of wood or coal without taking into account the greater convenience, saving of time, increase in output, etc. While in El Oro considerable activity has existed for many years so that the change to electric power has not been as noticeable; in Guanajuato the conditions have been quite different. In the latter camp a time was reached when the advancing cost of the necessary fuel made it impossible to profitably mine and mill the grades of ore obtainable. For this same reason development work had to be abandoned to a certain extent. When we compare the present Guanajuato with the above conditions which existed but about two or three years ago, all of which has been brought about by the introduction of electric power, the possibilities obtainable where this force can be applied seem unlimited.

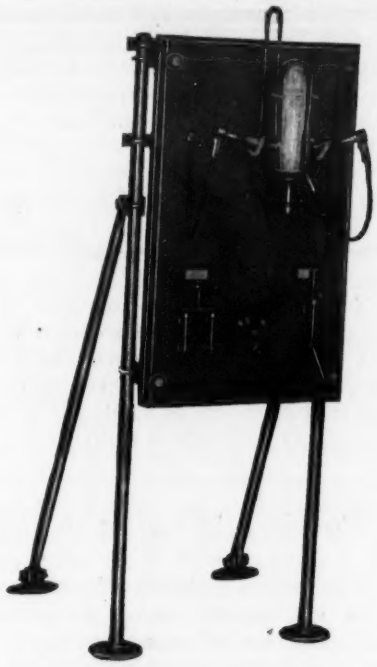
In Sinaloa, at the Black Mountain Mining Company's Camp, where electrical energy is employed entirely, it is generated by means of Westinghouse steam turbines at a greatly reduced expense. With installations for generating electricity, the generating stations can be located at a considerable distance from where it is to be consumed, in some wooded sections if available, from which place the energy is cheaply transmitted, gas or steam being generated from the wood. This is what we find in Parral where just such a plant is now going in to transmit to the mines about that place.

Another prominent camp which should be mentioned as being one of the first to adopt electric power and make use of it is Pachuca. A large amount of electrically-driven mining and milling machinery has been, and is still being, added to the various mines in this locality. The power in this camp is supplied by the Irrigadora Company. Until recently their large power plant at Juando was ample to supply the demand but they are now building a second plant equally as large, which will very shortly be in full operation. This company own sufficient water power to build even a third plant of about the same capacity and due to the business in sight this also may soon be developed to meet the popular demand for electrical energy.

In Oaxaca within the last six months or a year a few of the companies have ordered and will shortly have in operation isolated individual electrical plants for lighting and power in connection with their mining work.

Mercury Arc Rectifier Panel for Charging Ignition Batteries.

The mercury arc rectifier, as a substitute for the motor-generator set for charging vehicles, has already become familiar to the owners of electric automobiles. A smaller size of this form of apparatus for changing the alternating current of ordinary city lighting circuits to direct current for charging ignition batteries, will be of particular interest to owners of gasoline machines.



MERCURY ARC RECTIFIER PANEL.

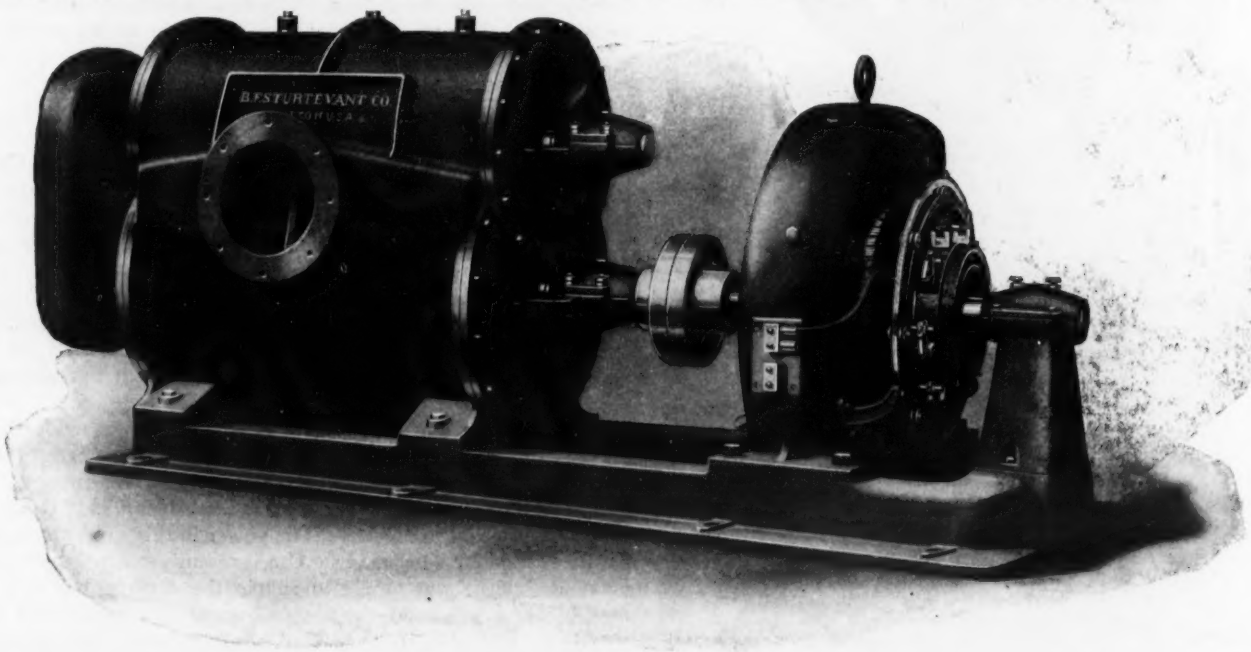
Storage cells are admittedly superior to any form of primary battery either wet or dry for ignition work, but are not as widely used as they could be owing to the inconvenient and expensive methods of charging. For storage batteries a direct current is required, and on city lighting circuits this is not always available, alternating current frequently being used for electric lighting. Even where direct current is available the voltage is higher than that necessary in charging from two to six cells of an ignition battery, and it is necessary to introduce a greater or less amount of wasteful resistance in series with batteries while they are charging. The mercury arc rectifier, developed by the General Electric Company to meet these conditions, consists of a mercury arc rectifier tube having a sufficient capacity to charge five cells of the ordinary ignition type. The tube is mounted compactly with switches and rheostat upon a slate panel 16 in. wide and 28 in. high. Referring to the illustration, in the lower right hand corner of the panel can be seen the starting switch, at the opposite side the load switch, while between the two is a small rheostat arranged in series with the load so as to adjust the voltage between the limits necessary for charging from two to five cells of battery.

Such a mercury arc rectifier outfit will charge a 5-cell ignition battery in eight hours. At ordinary rates for electric energy there is involved an expenditure of about 25 cents a week for keeping the batteries in first-class order. The outfit comes all set up on the panel with the exception of the tube, which can easily be hung in its supporting frame and connected.

Electrically Driven High-Pressure Blowers.

To complete its line of air and gas-moving machinery, the B. F. Sturtevant Company, Boston, Mass., placed upon the market a blower of the so-called positive or rotary type, as noted on page 335 of our issue for February 10, 1906. Realizing that in many installations the driving power contributes as much to success as the machine itself, particular attention has been given to the efficiency and reliability of the driving mechanism of the new type of blower. The best method of driving must be determined from the conditions of operation. Because of the wide-spread use of electricity, the motor drive is perhaps most frequently specified, and it may be a belted or geared set or direct connected. The complete line of motors built by the B. F. Sturtevant Company are adapted to all conditions of service.

For a belted or geared set a four or an eight-pole motor is suitable, and if geared, the motor should be mounted on the same bed plate with the blower, the reduction from the motor speed being accomplished by properly selected gears. A rawhide pinion is desirable on account of lessening the noise, or if a flexible connection seems imperative, some form of silent chain is favored. In case the motor is to be exposed to dust and dirt, as in a foundry installation, it is advisable to use an enclosed motor. Large eight-pole motors are especially well adapted to gearing, for less reduction in speed is required, but this type finds most favor for direct-connection.



High-Pressure Blower Driven by Low-Speed Motor.

The B. F. Sturtevant Company builds complete sets. The advantages of having all the component parts built by the same company are apparent. The design is harmonious, the materials and workmanship uniform, and the set is delivered ready for operation.

American Ball Generators.

Special interest attaches to several features of the American Ball generators and motors, particularly with respect to the armature construction. In building up the armature from soft steel laminations provision is made for blocking apart and separating the laminations in the center of the armature. The coil slots are milled out of the laminated core in the usual manner and the coils inserted. In separating the teeth of the core formed by the coil slots a device is employed, consisting of small slabs of tough fibre board, with shoulders that engage the teeth and hold them apart, maintaining a proper distance between the laminations necessary for the ventilating air duct. This device prevents any possible obstruction or closing of the ventilating duct, so that large quantities of cool air are free to pass through the armature, when revolving, affording an excellent ventilation, which is claimed to be much superior to that where the teeth are separated to form one or more air ducts by the insertion of small metal pieces, often fastening to one of the teeth of the core, the latter construction reducing the effective area of the air duct.

Another interesting feature of these dynamos and motors is the armature coil, which is formed of a solid bar of copper without soldered joints. The insulation consists of double windings of cotton thoroughly impregnated with insulating compound. The difficulty heretofore met in bending such copper bars to shape has been overcome by a special machine which receives the long strip of cotton-wound copper bars from the spool, and cuts it into proper lengths for the coils and bends it edgewise without injuring the insulation. The coils are treated with the insulating compound after they are formed.

The advantages claimed for these cotton-wound bar coils over coils formed of insulated wire are, first, that being less bulky, larger conductors can be inserted in a slot of given size; and second, these large conductors induce lower normal armature temperatures and greater capacity. For every degree Centigrade the resistance of copper increases about 0.4 per cent. Thus the armature heating is cumulative in its effect and when once begun seriously affects the capacity of the machine. It is for this reason that the makers lay particular stress upon the efficient methods employed to secure thorough ventilation and low resistance in the American Ball dynamos and motors.

Indurated Fibre Insulation.

In the early days of electric lighting, and until the Underwriters required the use of metal tubes, indurated fibre was largely used for interior conduit work, often being installed so as to be covered with plastering. As is well known, it is largely used in the manufacture of pails, jars and other household goods, for which purposes it has been found strictly water and weather-proof, withstanding the elements for years. Recently advantage has been taken of its excellent insulating properties to apply it to insulation uses. It is stated that ⅛-in. thickness of the material will withstand 23,000 volts without puncture or breakdown; that ¼-in. will withstand 35,000 volts, and ⅜-in., 46,000 volts.

Indurating fibre is now being manufactured by the Indurated Fibre Company, of Lockport, N. Y., as a covering for wire, especially when in exposed places, its elasticity and insulating and weather-proof properties rendering it particularly applicable for this use. It is also being employed for battery jars, transformer jars and covers, and the Western Union Company is using it for its resonators. One of the more important applications is in third-rail work. The New York Central Railroad originally intended to protect its third rail with a wooden covering, but after some experiments it was found that indurated fibre proved so satisfactory for this purpose that a considerable portion of the New York Central tracks in its electric zone near New York is now being equipped with this material. It is also being used on the under-running third rail system which the West Shore Railroad is installing between Utica and New York, and which is now about to be put in operation.

As used on the New York Central and West Shore, the indurated fibre is molded in sections 43½ in. long, so that it takes three sections to cover the third rail, as the latter is held in insulators 12 in. in length supported in brackets every 10½ ft.

FIG. 4.—NEW YORK CITY CONDUIT RAIL COVERING.

The joints in the indurated fibre covering are made by a 2-in. lap joint of the same material, as shown in Fig. 1, and a wider covering, illustrated in Fig. 2, is used at points where the third rail is bonded. One great advantage possessed by this material for this class of work is that it is much cheaper than the wood covering, principally for the reason that it can be installed much more easily, as it has simply to be slipped over the rail. The elasticity of the material will then hold the covering in place.

Two other applications of this material to electric railway work are also illustrated. Fig. 3 shows the section of a protecting covering used on the Manhattan Elevated and Subway systems in New York. The Subway third rail, it will be remembered, has a timber protection which prevents accidental contact from above, but as originally laid the third rail was not protected on the side. The indurated fibre protector is molded to fit the base of the rail between the ties and is carried up on the inside of the rail in the way shown. Its elasticity permits it to be slipped over the base of the rail, after which it holds itself in position.

Another application of this material to railway work has been made by the New York City Railway Company on its Thirty-third Street crosstown line, between First and Second Avenue. Last month 90 ft. of the conduit conductor rail was covered with the special form of indurated fibre molding shown in Fig. 4, which surrounds the rail with the exception of the flat surface on which the shoe of the plow slides. The insulation of the conductor in this case was made not so much to protect the rail against accidental contact as against corrosion and ammonia salts from the street. For this purpose it has answered excellently.

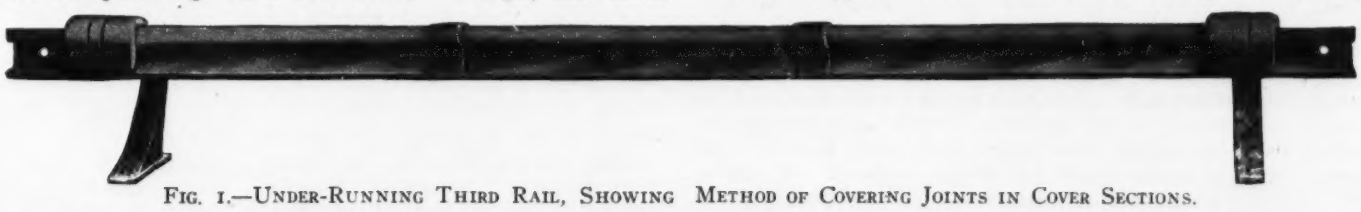


FIG. 1.—UNDER-RUNNING THIRD RAIL, SHOWING METHOD OF COVERING JOINTS IN COVER SECTIONS.

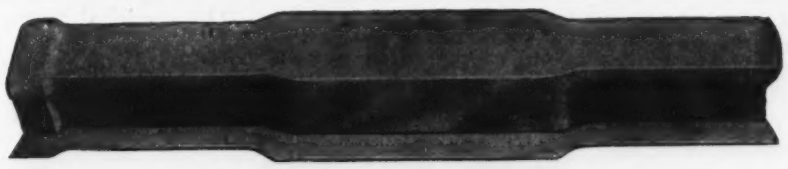


FIG. 2.—COVER FOR A BONDED JOINT.

FIG. 3.—SUBWAY AND ELEVATED PROTECTOR.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The weather conditions during the past week somewhat retarded trade in seasonable staple lines of merchandise, but holiday goods have begun to move unusually early and in a volume that promises satisfactory results. Wholesale business is in better condition than last year, and further improvement is noted in collections. From the leading manufacturing plants come reports of full employment of machinery, yet deliveries are much less prompt than desired and inadequate railway facilities receive a large share of the blame. Railway earnings thus far reported for November exceed last year's by 9.5 per cent. All monthly records of foreign commerce were eclipsed in October, the gain in exports being phenomenal. During last week at the port of New York there was a loss of $1,125,865 in exports and an increase of $3,084,098 in imports, as compared with the same week last year. Despite the approach of the close of a season of outdoor activities, there is still general complaint of the scarcity of labor, and railways, mills and factories are conceding advances in wages to hold their help, without, however, entirely satisfying demands presented. Taken as a whole, trade in first and second hands is at present more active than usual at this season, while retail trade is heavy. The demand covers a wide range and quality of purchases is exceptionally high. In the iron and steel trade demand is unprecedented for the season, prices still tend upward and imports of foreign iron are increasing. Demand for steel rails continues comparatively active and many roads are supplementing their early orders for 1907. Structural material is in good request. Steel bars are in active demand, a significant feature in this connection being orders for shaped bars for reinforced concrete work. Copper was firm and export demand for electrolytic for shipment in December was heavy. All domestic markets report increasing scarcity of casting and Lake for nearby requirements. For large tonnages of Lake and electrolytic from producers prices are strong at 22 to 23c. for electrolytic, January, February and March; Lake, for the same months, 22¾ to 23c. *Bradstreet's* reports 212 business failures during the week ending Nov. 22, against 222 in the preceding week, and 224 in the corresponding week last year.

THE COPPER SITUATION.—In its bulletin *Copper Gossip* the National Conduit & Cable Company, which consumes upward of 50,000,000 pounds of copper yearly, expresses its views on the copper situation as follows: "The advancing tendency in copper has resulted in market quotations of 22 to 22½ for electrolytic wire bars, and at these figures considerable business is reported. Consumers have had a very busy year, and a demand of unusually good dimensions has kept both big and small plants well filled with orders. We have to note a curtailment of operations in some quarters at the present time, and the strange coincidence in this connection is that with certain consumers using less copper than earlier in the year, there is a reported scarcity of the metal for prompt delivery. Of course the present high price of copper tends to make manufacturers conservative, and at the present level of values we are not inclined to advise our customers to anticipate their requirements any further ahead than they are absolutely sure that they can work up stock bought on the basis of present prices. It is not a time to do any pyramiding on the top prices recorded in more than twenty years. There is no desire to deny the remarkably healthy trade conditions which have marked 1906 as a year of exceptional prosperity, but we submit that there is a limit beyond which prices ought not to be forced, even though temporary conditions might contribute to the success of the operation."

CROCKER-WHEELER SALES.—Among the recent sales secured by the Crocker-Wheeler Company, of Ampere, N. J., appear the following who have learned from experience that Crocker-Wheeler motors and generators make good. The sales are as follows: One 100-kw, 120-volt, 900-r.p.m., direct-current generator to the De Laval Steam Turbine Co., of Trenton, N. J. One 1,000-kw, direct-current generator to the National Tube Co., of McKeesport, Pa. One 235-hp, 250-volt, direct-current generator and 225 direct-current motors from 2 to 50 hp to H. L. Judd Company, of Wallingford, Conn., all of 230 volt. Three transformers to the Southern Railway Company, Nashville, N. C.

RIDGWAY MACHINE TOOL.—The Niles-Bement-Pond Company has made arrangements to purchase the plant of the Ridgway Machine Tool Company of Ridgway, Pa. This will in no way affect the Ridgway Dynamo & Engine Company. The two companies have always been operated separately, and the Dynamo & Engine Company will continue as before. It is understood that the Niles-Bement-Pond Company will complete all the contracts now in the hands of the Ridgway Company. The latter company has a large plant specially adapted for the manufacture of heavy machine tools.

THE KERR TURBINE CO., of Wellsville, N. Y., through its Philadelphia agency, B. Remmers & Sons, 326 The Bourse, has secured the contract for the new power plant to be installed in the Bennett Building, Fulton and Ann Streets, New York City. The power plant, to consist of steam turbine generators, of a combined capacity of 200 kw, will be made up of 75-kw Burke generators, 125 volts, direct-current, each direct-connected to a 24-in., 6-stage Kerr turbine, and one 50-kw, 125-volt, direct-current Burke generator, direct-connected to an 18-in., 6-stage Kerr turbine.

INDEPENDENT TELEPHONY.—Special dispatches from Columbus, O., say that St. Louis capitalists, among them Adolphus Busch, the brewer, have been inspecting the line of the U. S. Long Distance Telephone Company, of Ohio, which is one of the connections of the telephone system controlled by the St. Louis men. If their plan is carried out they will have representative trustees in the United States Company by the purchase of unsubscribed common stock. The syndicate has secured an entrance into Chicago, and plans an extension to New York and Cincinnati.

BLOCK SIGNAL CONTRACT.—The railroad companies have never paid so much attention to the safeguarding of their tracks as at the present time. An important contract for the installation of the automatic block signal has been placed by the Boston & Maine R. R. with the Union Switch & Signal Company for all the material necessary over at least one thousand miles of track. The work involves an expenditure of several hundred thousand dollars and is one of the largest single contracts for automatic block signaling that has ever been placed.

TELEPHONY IN OMAHA.—The Independent Telephone Company of Omaha has let a contract for the construction of an automatic telephone system in Omaha. The contract is for $1,500,000 and goes to the Crescent Construction Company, of Portland, Ore. Work begins immediately. A franchise was voted the Independent company at the November general election.

LARGE TOOL REQUIREMENTS.—The General Electric Company has just sent to the trade a list of machine tools that will be required for the equipment of the new shops now under construction at its works at Lynn, Mass. The list is a heavy one, aggregating upward of $250,000. The new turbine shop at Schenectady makes a formidable demand of the same kind.

FIRE IN FACTORY.—The factory of the Atlantic Insulated Wire & Cable Company, at Stamford, Conn., was totally destroyed by fire on Nov. 15, entailing a loss of $400,000, which is fully covered by insurance. The contract for new buildings was let while the ruins were still smoking, and the company expects to fully resume business in 60 days.

CENTRAL AMERICAN LIGHTING.—The city of Santa Anna, Salvador, Central America, will have electric lighting for its streets, stores and houses. The municipal authorities have contracted for the complete installation of electrical machinery of the Westinghouse type, operated by the water power of the Santa Anna River.

PROPERTIES IN MICHIGAN.—Granger Farwell, of Chicago, holder of the bonds, has purchased the properties of the Marquette County Gaslight & Traction Co. at sale at Ishpeming, Mich., for $289,000, which amount covers the bonded indebtedness and obligations contracted under the present receivership.

BOSTON & MONTANA.—The Boston & Montana mine is planning to install a complete underground electric power system for the transportation of ore from the workings to the shaft. The new equipment has been ordered and includes a number of small electric engines to take the place of men and horses.

STEAM ENGINE ORDERS.—Following is a digest made by the steam engine department of Allis-Chalmers Company: Inland Steel Co., Indiana Harbor, Ind., two 20-inch and 42x42-inch Reynolds heavy-duty cross-compound engines, direct connected to two 550-kw, direct-current Allis-Chalmers generators; Mobile Light & Railroad Co., Mobile, Ala., 28-inch and 58x60-inch Reynolds heavy-duty cross-compound Corliss engine; Kankakee Tile & Brick Co., Kankakee, Ill., 13x30-inch Reynolds Reliance Corliss engine; Fred W. Wolf Co., Chicago, for Jos. Schlitz Brewing Co., Milwaukee, two 30-inch and 56x42-inch Reynolds heavy-duty cross-compound Corliss engines, two 32x12-inch Reynolds jet condensers and air pumps; South Baltimore Steel Car & Foundry Co., Baltimore, Md., 22x48-inch Reynolds heavy-duty Corliss engine, 250-kw, alternating-current generator, 9-kw exciter. Larsen-Baker Ice Machine Co., Omaha, Neb., 12x24-inch Reynolds Reliance Corliss engine; Allis-Chalmers-Bullock, Ltd., Montreal, Can., for Weyburn Machine & Electric Light Co., Weyburn, Saskatchewan, Canada, 14x24-inch Reynolds Reliance Corliss engine; Prendergast Lumber & Coal Co., Marion, Ohio, 14x36-inch Reynolds Reliance Corliss engine; American Smelter Securities Co., New York, two 14-inch and 28x36-inch Reynolds Reliance cross-compound Corliss engines; Chicago Brass Co., Kenosha, Wis., 20-inch and 42x42-inch Reynolds heavy-duty cross-compound Corliss engine, 550-kw, 240-volt Allis-Chalmers generator; M. Strauss & Sons, Newark, N. J., 16x36-inch Reynolds Reliance Corliss engine, 150-kw Allis-Chalmers generator with 13-kw exciter, 20 Allis-Chalmers motors and an Allis-Chalmers panel switchboard; Ventura County Power Co., Ventura, Cal., 16-inch and 32x36-inch Reynolds heavy-duty tandem-compound Corliss engine, 300-kw Allis-Chalmers generator; Swift & Co., Harrison, N. J., 24x48-inch Reynolds heavy-duty Corliss engine; S. H. Harmon Lbr. Co., San Francisco, Cal., 22x42-inch Reynolds heavy-duty Corliss engine; Douglas Improvement Co., Douglas, Ariz., 16-inch and 32x36-inch Reynolds vertical cross-compound Corliss engine, 325-kw Allis-Chalmers generator; American Trading Co., Kobe, Japan, 18x48-inch Reynolds heavy-duty Corliss engine; Ruemmeli-Dawley Mfg. Co., St. Louis, Mo., 14x24-inch Reynolds Reliance Corliss engine; Vaughn & Bushnell Co., Chicago, Ill., 14x36-inch Reliance Reynolds Corliss engine; Enfield Construction Co., Windsor Locks, Conn., 16x30-inch Reliance Corliss engine; Oliver Iron Mining Co., Duluth, Minn., 32x12-inch Reynolds steam-driven jet condenser; Carquinez Brick & Tile Co., San Francisco, Cal., 20x48-inch heavy-duty Reynolds Corliss engine; Jefferson Cotton Mills, Jefferson, Ga., 14x42-inch heavy-duty Reynolds Corliss engine; Johnson-Wentworth Co., Cloquet, Minn., 20x42-inch Reynolds heavy-duty Corliss engine; United States Crushed Stone Co., McCook, Ill., 18x42-inch Reynolds Reliance Corliss engine; Central Electric Co., Chicago, for Pullman Co., Pullman, Ill., 16x36-inch Reynolds Reliance Corliss engine, 250-kw Allis-Chalmers alternator, 12½-kw exciter; Peerless Woolen Mills, Rossville, Ga., 20x36-inch Reynolds Reliance Corliss engine, 250-kw Allis-Chalmers belted alternator with 9-kw belted exciter, seven induction motors, ranging from 15 to 75 hp, and one switchboard; Electrical Installation Co., for the Indianapolis, Crawfordsville & Western Traction Co., Crawfordsville, Ind., main stations—two 20-inch and 42x42-inch Reynolds horizontal cross-compound Corliss engines, two 700-kw Allis-Chalmers generators, 12-kw exciter, six 250-kw transformers, 50-kw motor-generator set, 300-kw rotary converter, 40-kva reactive coil; sub-stations—three 300-kw rotary converters, nine 110-kw transformers, three 45-kva reactive coils, car equipments, 10 Allis-Chalmers 75-hp railway motor equipments, 10 air brake equipments; Rhode Island Worsted Co., Stafford, Conn., 20x36-inch Reynolds Reliance Corliss engine, 225-kw Allis-Chalmers alternators, one 50-hp induction motor, switchboard and fixtures; Societe Anonyme "L" Almendares, Havana, Cuba, 22-inch and 44x42-inch tandem-compound heavy-duty Corliss engine.

TELEPHONE DEVELOPMENT.—Plans for 1907 have been officially announced by the Northwestern Telephone Company. Expenditures will be made aggregating $2,500,000. Of this amount, $1,000,000 will be spent in Minneapolis and St. Paul. A 9,000-line switchboard will go into the new Minneapolis building. Several buildings for branch exchanges will be erected. During 1906 the company spent over $1,000,000. It built 327 miles of pole lines in Minnesota and North Dakota, strung over 7,000 miles of copper wire in the country and laid 460,000 feet of underground wire in Minneapolis and St. Paul.

CONSUMPTION OF COPPER.—The Government gives the estimated home consumption of copper in the United States in 1905 as 581,006,325 pounds. The actual consumption was probably close to 600,000,000 pounds. The supply of copper available for the United States in 1905 was 1,112,632,528 pounds, of which the imports were 210,700,000 pounds. The exports for the year amounted to 552,600,000 pounds.

PLANT FOR JAPAN.—The Imperial Steel Co. of Japan is to operate its factories by electricity. The company has made a contract with the Westinghouse Companies for two 500-hp Westinghouse-Parsons steam turbines, two generators of the same capacity, and for transformers and switchboard apparatus.

THE CHASE-SHAWMUT COMPANY, of Newburyport, Mass., has recently received an order from the Northern Electric Company, of Chico, Cal., for 61,000 rail bonds for installation on its road. This is in connection with an order for 33,500 rail bonds recently received from the same company.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was dull and steady with a strong undertone, but notwithstanding an apparently improved financial outlook, active speculation was restricted by high money rates. Prices for a number of the leading high-priced and closely-held issues were the objects of more or less effective bullish manipulation. At the close of the week the market, in spite of rather easier money, was heavy in tone. Standard Oil tended to recover from its recent break, the Street arguing that the proceedings against the company can lead to no confiscation, and that some way of guarding the stockholders' equities will be devised, but on Friday the decline was renewed, apparently due to liquidation. There were no marked features among the electrical securities, and no changes of importance in quotations were recorded. Allis-Chalmers preferred closed the week with a net loss of ¾ of a point, and General Electric gained 1 point, the last quotation of the week being 176½. Westinghouse was unchanged from the last previous quotation—155. American Locomotive common closed at 74½, this being a net decline of 1¼ points, and preferred at 111¾, a loss of ¼ point.

NEW YORK

	Nov. 20	Nov. 27		Nov. 20	Nov. 27
Allis-Chalmers Co.	17⅛	17⅜	General Electric	178	175⅛
Allis-Chalmers Co. pfd.	46	45	Hudson River Tel	...	...
American Dist. Tel	25	25	Interborough Rap. Tran.	...	...
American Locomotive	75¼	74⅛	Mackay Cos.	73	72⅜
American Locomotive pfd.	111	111	Mackay Cos. pfd.	...	68⅝
American Tel. & Cable	88	88	Marconi Tel	...	...
American Tel & Tel.	...	...	Metropolitan St. Ry.	...	...
Brooklyn Rapid Transit	78	79	N. Y. & N. J. Tel.	...	...
Electric Boat	24	30	Western Union Tel.	85¾	87¾
Electric Boat pfd.	70	75	Westinghouse com.	154	150
Electric Vehicle	...	12	Westinghouse pfd.	...	...
Electric Vehicle pfd	...	17			

BOSTON

	Nov. 20	Nov. 27		Nov. 20	Nov 27
American Tel & Tel.	137½	136	Mass. Elec. Ry. pfd	69½	69⅛
Cumberland Telephone	...	117¾	Mexican Telephone	3¾	4¾
Edison Elec. Illum.	232	228½	New England Telephone	129¼	129
General Electric	180¼	176¾	Western Tel. & Tel.	...	9
Mass. Elec. Ry.	19	19	Western Tel. & Tel. pfd.	80	80

PHILADELPHIA

	Nov. 20	Nov. 27		Nov. 20	Nov. 27
American Railways	51⅛	51⅛	Phila. Electric	8⅝	8⅝
Elec. Co. of America	12	11⅞	Phila. Rapid Trans	21¼	21⅛
Elec. Storage Battery	70	70	Phila. Traction	...	97
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Nov. 20	Nov. 27		Nov 20.	Nov. 27
Chicago City Ry.	...	160	National Carbon	86	85
Chicago Edison	143	144	National Carbon pfd.	117	*119
Chicago Subway	51¾	50	Union Traction.	...	...
Chicago Tel. Co.	118	...	Union Traction pfd.	...	...
Metropolitan Elev com.	26	26			

A good business was done in Brooklyn Rapid Transit at prices ranging from 77⅝ to 81⅝, the closing quotation being 79¼, which is an advance of ¾ point. The Interborough-Metropolitan issues are both down, common ⅞ of a point and preferred 1 point, the closing quotations being 36⅝ and 76¾, respectively. Havana Electric Railway common is quoted at 47 and preferred at 87. Western Union made a net gain of ⅛ point, the closing quotation for the week being 85½; and American Telegraph & Cable advanced 1 point, closing at 89. The market for outside securities was for the most part featureless, excepting a general desire to take profits. This caused numerous recessions. A further sharp decline in Standard Oil to a new low record for a number of years past was the feature. Tractions in this issue were rather large, the principal sellers, it was reported, being small shareholders who were frightened at the court proceedings against the company. The closing quotations of November 27 are given in the accompanying table:

NORTH SHORE ELECTRIC REPORT.—The North Shore Electric Company, which gives electric light and power service in the majority of the suburban towns around Chicago, and which now has a long chain of power houses and transmission systems, has made public its report for the year ending Sept. 30. The company has done a great deal of construction work the past year and has also acquired some new properties, as is shown by the following statement of gross earnings for the past three years and the balance sheets for the past two years. The company is completing a large power station at Maywood, due west from Chicago, and has begun work on stations at Blue Island to the south and Waukegan on the north.

	1904.	1905.	1906.
Gross earnings	$224,637	$370,831	$544,242
Operating expenses	147,033	239,155	355,935
Net	$77,604	$131,676	$188,306
Interest	35,252	65,277	95,392
Surplus	$42,351	$66,398	$92,914

The balance sheets compare as follows:

ASSETS.

	1905.	1906.
Plants, real estate, etc.	$3,162,948	$4,859,327
Expenditures on customers' contracts	2,456	3,296
Accounts and bills receivable	83,353	126,386
Cash	80,454	167,121
Materials on hand	18,071	39,355
Open accounts	6,566	8,899
Total	$3,353,851	$5,204,385

LIABILITIES.

Capital stock	$1,600,000	$2,500,000
Bonds	1,500,000	2,050,000
Surplus	115,686	169,100
Accounts and bills payable	53,965	347,835
Bond interest accrued	37,500	51,250
Depreciation reserve	46,700	86,200
Total	$3,353,851	$5,204,385

The officers and directors of the company are as follows: President, Samuel Insull; vice-president, Frank J. Baker; secretary and treasurer, F. W. Insull; directors, Samuel Insull, L. A. Ferguson, F. J. Baker, Charles W. Spalding, E. P. Russell, W. A. Fox and C. H. Randle.

SPOKANE & INLAND EMPIRE.—N. W. Harris & Co. are offering at par and interest $2,743,000 Spokane & Inland Empire Railroad first and refunding 5 per cent bonds. The property on which these bonds are secured is a consolidation of the Spokane Traction Co., Spokane Terminal Co., Cœur d'Alene & Spokane Railway Co., Spokane & Inland Railway Co. and the Spokane Power Development Co. It is a trolley freight and passenger system. The estimated earnings from the first year's operation of the entire 180 miles of railroad are as follows:

Gross	$1,069,000
Operating expenses	641,400
Net	$427,600
Interest on bonds	197,950
Surplus	$229,650

ELECTRICAL SECURITIES CORPORATION.—The report of the Electrical Securities Corporation for the year ended Oct. 31, last, compares as follows:

	1906.	1905.	Increase.
Total receipts	$542,930	$326,022	$216,908
Expenses and interest	233,131	237,434	*4,303
Net profits	309,798	88,588	221,210
Preferred dividends	50,000	50,000	..
Balance	259,798	38,588	221,210
Dep. book val. stks.	14,991	..	14,991
Surplus	244,807	38,588	206,221

*Decrease.

TREMENDOUS TRAFFIC.—The combined elevated and underground system of the Interborough Rapid Transit Company, of New York, took in 1,486,777 nickels on Monday, November 26, and established a new record for the heaviest day of traffic. More passengers were carried than ever before in the history of the combined or separate companies. The income for the day to the company was more than $74,000. The passengers carried on the elevated lines not only exceeded the high record for last year, but passed the record for 1904, which has been the banner year thus far, showing that it has not only regained the traffic originally lost to the Subway, but is now carrying larger crowds than ever. The elevated lines carried 917,143 passengers, an increase of 88,235 over the corresponding day last year, a gain over the best day in 1904. The Subway carried 569,634 passengers, which is an increase of 83,324 passengers over the corresponding day of last year. On this business of one day the total revenue of the Manhattan lines and the Subway shows an increase of $8,534.92 over the corresponding day of last year.

ELECTRICITY IN ST. LOUIS.—President Charles W. Wetmore, of the North American Company; E. M. Bulkley and C. D. Smithers, New York; Harry Selig, Memphis; John I. Beggs, president of the United Railways Company, and others interested in the North American Company, held a meeting last week in the office of the Union Electric Light & Power Company, St. Louis. Mr. Beggs said in an interview that the report that the North American Company was preparing to erect a mammoth office building in St. Louis was erroneous. "Ultimately there may be erected in St. Louis an office building, which will be made the headquarters for all concerns in St. Louis controlled by the North American Company. This, however, is not a settled fact. Should such a building be constructed it will be done by St. Louis institutions and not by the North American Company. There was nothing along that line discussed at the meeting. There will be nothing done during my visit to the city which will have a bearing on the consolidation of the Suburban Railway Company with the United Railways."

UNDERWRITING WESTERN UNION.—Following the announcement of the terms on which the stockholders of the Western Union Telegraph Company are offered subscription privileges to part of the new issue of $25,000,000 4 per cent convertible bonds, it was made known that the bonds have been underwritten by a syndicate formed by Kuhn, Loeb & Company. The terms offered to the stockholders allow them to take the bonds at the price of $875 per $1,000 bond to the extent of 10 per cent of their respective holdings of stock. There are $97,370,000 worth of stock outstanding, which makes the total amount of the bonds offered at present $9,737,000. The bonds are convertible at the option of the owner at par at any time after January 2, 1909, and before January 2, 1919. They are redeemable at the option of the company at 5 per cent premium and interest on May 1, 1912, or any interest day thereafter on notice. The coupon bonds of the present issue will be dated June 2, 1907, and all the bonds will mature November 1, 1936.

GENERAL ELECTRIC STOCK.—The stockholders of the General Electric Company at their meeting in Schenectady last week ratified the plan to increase the company's authorized capital stock from $60,000,000 to $80,000,000. About $11,000,000 of additional stock, or 20 per cent of the amount now outstanding, will be issued in the near future to provide additional working capital and increased manufacturing facilities. The remainder of the stock will remain in the treasury for future requirements. The company now has unissued, apart from the increase authorized last week, about $5,000,000 of stock, so that only about $6,000,000 of the newly authorized stock will be included in the $11,000,000 which is to be offered to the stockholders at par. Calculating the rights to be worth $13.50, stockholders have received a total of $28 in rights during the past three years, or about $9 per share each year, making the total return per share, including dividends for the past three years, $17 per share.

UNDERGROUND CABLE.—A special meeting of the stockholders of the Standard Underground Cable Company has been called for January 22 to act on a proposed increase in the capital from $2,000,000 to $3,000,000. It is understood that part of the increase will be in the nature of a stock dividend. The company was originally capitalized at $1,000,000. In 1899 it was increased to $1,500,000, 40 per cent as a stock dividend and $100,000 sold to stockholders at par. In 1902 the capital was increased another $500,000 by a sale to stockholders at par.

PRICE OF ELECTRIC STOCKS.—It is noted that the stocks of the electric manufacturing companies show irregular changes in five years. General Electric with a decreased dividend is selling much lower. The Westinghouse issues with higher dividend rates show but slight gains. Allis-Chalmers common and preferred are both lower. The appended table shows the dividend rates and price changes in 1901 and 1906:

	Div. rate.		Nov. 26			Decline five
Name.	1906.	1901.	1906.	1905.	1901.	Years.
Gen. Elec.	8	9	175	188	268	93
West. Elec.	10	6½	155	175	145	†10
West. El. pf.	10	7	162	190	157	†5
All.Chalm.	..	..	17½	21	*21	3½
All.-Ch., pf.	..	7	45½	62½	*82	30½

†Advance. *Nov., 1904, first traded in.

TELEPHONY SOUTH.—The National Telephone Company, of Wheeling, W. Va., one of the largest of the independent telephone companies, will be reorganized, following a contest for control between President Henry Schumelbach and his friends and John A. Howard and his friends. The latter proved successful and have taken over the holdings of the president, who, with L. J. Bayha, a director, has resigned all official connection with the company. The contest grew out of a difference over the managing policy.

BOSTON EDISON STOCK INCREASE.—It appears that from the proceeds of the sale of 24,000 shares of new stock authorized at a special meeting of the Edison Company of Boston at its meeting November 20, there will probably be realized $4,840,000 at $200 a share. The company will shortly file a petition with the gas commissioners for authority to issue this new stock, but it is not the intention of the directors to issue all of it at once. It is proposed to issue half the amount next May, and the remainder in 1908, which arrangement will permit a 10 per cent increase in each instance. The new stock is necessary to fund the floating debt now in excess of $2,000,000, and to pay for extensions and improvements to plant to take care of the constantly increasing business. A new turbine was ordered this year, and another will be ordered next year, which will necessitate the building of two additional sections to the new L street power house now comprising four sections. The increase in the business of the Edison Company for the fiscal year ended June 30 was the largest for any year in its history, and the expansion thus far this year shows no diminution. For the fiscal year ended June 30 last there was a net increase of horse-power connected to the system of 4,015 hp, with a total connection of 30,431 hp, while for the quarter ended September 30 there was an increase of 1,870 hp, or 46 per cent of the increase for all of last year. In October the Edison Company booked 825 new customers, 22,868 new incandescent lights, 111 arc lights, 737 hp of motors, amounting in all to 38,261, 16-cp equivalents, an increase in new business of 35 per cent over October, 1905. Discontinuances for October were only 6,047 equivalents, of which nearly half was due to removals.

PORTLAND, ORE., MERGER.—C. M. Clark, of Philadelphia, and his associates have been in Portland arranging the final details of the $30,000,000 merger which was formed some time ago, and which controls all the larger electrical interests of Portland and the Willamette Valley, under the name of the Portland Railway, Light & Power Company. The following interests, formerly individual, after the merger has been finally completed, will be consolidated into the new company: Portland General Electric Company, Portland Railway Company, Oregon Water Power & Railway Company, Citizens' Light & Traction Company, of Salem, Vancouver Electric Light & Power Company, and the Union Light & Power Company, which supplies light and power for Silverton, Mount Angel and Woodburn. By December 1 the new company expects to be supplying Portland with power from its new Cazadero hydro-electric plant. The three units being installed will have a capacity of 15,000 hp, and two more 5,000-hp units will be added when needed. The new transmission line to Portland is now being erected. The new sub-station of the Portland Railway, Light & Power Company, on Knott Street, near Williams Avenue, is nearly completed and will be in operation in December. The plant will furnish electricity for operating the street railway system in that part of the city, as well as to the commercial light and power lines. The sub-station will be connected with the Cazadero power plant, the city steam plant and the Oregon City power station.

MANHATTAN RAILWAY STOCK.—It is announced that the 48,000 shares of the Manhattan Railway Company, which have remained in the treasury of the Manhattan since the lease was made to the Interborough Rapid Transit Company, will be sold at auction November 28. Permission to issue this stock was recently secured from the state railroad commission. Permission, also, to list it on the New York stock exchange as sold and issued has been granted. The stockholders of the Manhattan Railway Company authorized the issue of this stock at any time after January 1, 1906, at a special meeting held January 16, 1903. It was stipulated that the proceeds to be derived from the sale were to be used in payment for improvements and equipment. The indebtedness of the Manhattan to the Interborough Rapid Transit Company on September 30 for direct advances amounted to $3,452,183. This indebtedness will be wiped out with the proceeds of the sale, and the surplus will be used for further improvements. As a result of the issue, the annual fixed charges of the Interborough will be increased $336,000, as dividends of 7 per cent per annum will have to be paid on the stock the same as on that already outstanding. The total authorized and outstanding stock of the Manhattan will amount to $60,000,000, calling for dividends of $4,200,000 a year when the additional stock is issued.

ROCKY MOUNTAIN POWER.—Advices from Cleveland, O., note that at the head of a $9,000,000 syndicate, Myron T. Herrick, of Cleveland, and Thomas F. Walsh, of Denver, purpose to harness cataracts and streams of the Rockies for long-distance transmission. For the present only territory within a radius of 110 miles of the central power plant will be embraced. Later a general broadening out is contemplated until the whole middle west is taken in. The great Gore Canyon, the Grand, South Platte, Kiowa and Bijou Rivers in the vicinity of Denver will be utilized. The South Platte River has its source 11,176 feet above tide, and its fall in the short distance to Denver is 6,000 feet. Its average depth is 7 feet and the width 25 feet. A canal from the Niagara River 12 feet serves the station with sufficient water to generate 100,000 horse-power. A comparison is favorable to the project. The partially completed plans embrace the erection of a power house of 100,000 horse-power capacity near the great Gore Canyon, 25 miles west of Denver. From this station electrical power will be distributed to various places in Colorado within a radius of 110 miles.

CHICAGO SUBWAY AND EDISON.—It is stated that the plans for the union of the Chicago Edison Company with the Chicago Subway have been changed, so that instead of a guarantee of dividends reaching 9 per cent, the Chicago Subway, through a sub-company, will issue $27,000,000 4½ per cent 50-year bonds for the $13,500,000 share capital of the Chicago Edison Company. This will guarantee the 9 per cent dividends of the Chicago Edison Company. The stock will be placed under the collateral trust 4½ per cent bonds. It is estimated that the development of the Chicago Edison Company will require $15,000,000 in the next five years, which the Chicago Subway must furnish in one way or another. To cover these requirements and the financing of the subway a blanket mortage of $100,000,000 is under consideration. Eighty per cent of the Chicago Edison Company shareholders have signified directly and indirectly their assent to the sale of their stock to the Chicago subway.

NILES-BEMENT-POND STOCK.—At the special stockholders' meeting of the Niles-Bement-Pond Company, held in Jersey City, the proposed amendment of the charter authorizing an increase of the common stock from $5,000,000 to $8,500,000 was ratified. The increase of $3,500,000 in the common stock of the Niles-Bement-Pond Company will be offered to stockholders upon the terms to be determined at a meeting of the board. The proceeds will be used to reimburse the treasury with money appropriated for outside investments and for general improvements and additions to plants.

WESTERN UNION BONDS.—The stockholders of the Western Union Telegraph Company, at their special meeting, authorized the issuance of $25,000,000 4 per cent redeemable, convertible bonds, to be dated November 1, 1906, and to mature November 1, 1936. The bonds are convertible after two years, and not more than twelve years, into the capital stock of the company, which has also been increased sufficient to provide for the conversion.

SCRANTON MERGER.—It is reported here that all the holdings of the Suburban Electric Light Company have been taken over on leave from the Electric Company of America by the American Light and Traction Company, of New York. All the companies in the city, with the exception of the recently organized Lackawanna Light Company, are said to be included. Among them are the Suburban Electric Light Company, the Dunmore Heat, Light & Power Company, the Priceburg & Dickson City Electric Light Companies, and the Scranton Illuminating, Heat & Power Company.

HUDSON TUNNEL.—Articles have been filed with the secretary of state increasing the capital stock of the Hoboken & Manhattan Railroad Company from $500,000 to $15,000,000, and the capital of the Hudson & Manhattan Railway Company from $100,000 to $17,100,000. These companies were formed to construct the New Jersey end of the tunnels under the Hudson River by the syndicate headed by William G. McAdoo.

AUTOMATIC TELEPHONE.—The entire unsold balance of the capital stock of the Automatic Electric Company of Chicago, $864,000, has been sold. The company has $2,737,851 of orders on its books for delivery before March 1, 1907. Unfilled business for delivery after March 1, 1907, aggregates $3,500,000. In other words, the unfilled business on the books of the company represents about 125 per cent of the capital stock of $5,000,000.

RHODE ISLAND TROLLEYS.—The Consolidated Securities Company, which controls the electric lines owned by the New York, New Haven & Hartford Railroad, has purchased the Woonsocket Street Railway, the Providence & Burrillville Street Railway, and the Milford, Attleboro & Woonsocket Street Railway. The purchase is believed to involve more than $1,000,000.

CUMBERLAND TELEPHONE.—The Cumberland Telephone & Telegraph Company reports an October gross of $449,559, a ten months' gross of $4,596,250, and a surplus for the longer period of $1,509,868.

GENERAL NEWS.

Construction News.

ADA, ARK.—An issue of $40,000 in bonds has been authorized for the construction of a light and water plant.

FT. SMITH, ARK.—Haskett & Reeves will soon let the contract for 5 miles of electric railway to be constructed to the suburban factory site, south of city.

SAN DIEGO, CAL.—The City Council has been petitioned by the San Diego Electric Railway Company for franchises to operate and construct three new lines of railway in the city.

LOS ANGELES, CAL.—Carl Leonardt has secured the contract to construct a power house at Ocean Beach sub-division, Redondo Beach, for the Pacific Light & Power Company, at $72,000.

SANTA ROSA, CAL.—The Electric Lighting Company has applied to the Council for a franchise to furnish electricity for heating and power purposes in this city. It is stated that bids for said franchise will soon be asked by the Council.

SAN DIEGO, CAL.—The Common Council has submitted three amendments to the city charter to a vote of the people on Jan. 29. The purpose of the amendments is to empower the city to issue bonds for building a railway to the Colorado River.

SANTA BARBARA, CAL.—The Board of Supervisors has granted a franchise to the Merchants Mutual Electric Light & Power Company to erect poles and wires for transmitting electricity for heat, light and power along certain highways of the county.

POMONA, CAL.—The franchise for the construction of an electric railway through Holt, Garey and Fifth avenues and Second Street, has been sold to the Pacific Electric Railway, which is now under bond to have three miles of railway in operation in Pomona City within one year.

SAN BERNARDINO, CAL.—A. C. Denman, Jr., president and general manager of the San Bernardino Valley Traction Company, has secured the right of way from Colton to Riverside, and bought a franchise of the Riverside City Council to do business in that city. In addition to the Riverside franchise, the County Council of Colton has granted the application of Mr. Denman for a franchise, which will be sold at once.

OROVILLE, CAL.—The Western Power Company has established its office in this place, which will be in charge of M. A. Viele, of the engineering firm of Viele, Cooper & Blackwell, from which he will direct the construction of the company's large plant at Big Bend. Work has commenced on the new tunnel, which will be 3,500 feet long and will run from the old tunnel up to North Fork. The present plans call for the development of 50,000 hp, but the total capacity of the plant will reach 100,000 hp. The company contemplates an expenditure of between $5,000,000 and $6,000,000.

GUNNISON, COL.—The Council is contemplating an expenditure of $50,000 in improving the electric light and water plant.

LONGMONT, COL.—The Rocky Mountain Power & Transmission Company is erecting a power plant in the mountains west of the city, which will have a capacity of 6,000 hp when completed.

HARTFORD, CONN.—The Consolidated Railway Company contemplates extending its Albany Avenue line westward toward Bloomfield, in the near future.

DAYVILLE, CONN.—The People's Light & Power Company, of Danielsville, has submitted a proposition to the village of Dayville, offering to extend its lines to this place and furnish electricity for lighting, if sufficient business is assured.

WASHINGTON, D. C.—Bids will be received at the office of the superintendent of the U. S. Capitol buildings and grounds until Dec. 26, for furnishing and erecting apparatus to completely equip the heating, lighting and power plant for the Capitol Building and other buildings, which will consist of engines, generators, switchboards, boilers, pumps, condensers, steam fitting and all other necessary appliances, and for the complete substation apparatus for the various buildings. Proposals for the generators, substation apparatus and for switchboard equipment will be received until December 26. Subsequent proposals will be received for the other apparatus, for which the date of opening will be stated in the specification. A certified check in the sum of $50 will be required and a guarantee for the return of plans and specifications. Elliott Woods is superintendent.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Dec. 11, to furnish at the navy yards, etc., Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Washington, D. C.; Norfolk, Va.; Charleston, S. C., and Port Royal, S. C., a quantity of naval supplies as follows: Schedule 281—arc lamps, electric wire and cable, panel board, cross-arm pins, insulators, arc lamp brackets and pulleys, conduit, mica, receptacle boxes, circuit breakers, cluster fixtures, electrical supplies, etc. Schedule 284—elevating and rammer equipments, motor, pneumatic hammer and drills, etc.; also until Dec. 18 to furnish at the navy yards, Mare Island, Cal., and Puget Sound, Wash., and the naval training station, San Francisco, Cal., a quantity of naval supplies, as follows: Schedule 274—telephone switchboard. Schedule 275—ammeters, circuit breakers, wire, fuses, sockets and receptacles, bells and buzzers, electrical supplies, etc. Schedule 277—elevating and rammer equipment, ammeter, testing set, tachometer, hydraulic jacks, cutters, tools, etc. Schedule 278—cable, motor, electrical supplies, etc. Schedule 279—steel plates, sheet copper, copper pipe, condenser tubes, thermit, etc. Application for proposals should designate the schedules desired by number. E. B. Rogers, Paymaster-General, U. S. N.

ATLANTA, GA.—The Georgia Railway & Electric Company has been granted a franchise in Hapeville.

BRUNSWICK, GA.—The purchase of the local electric light and water works plant is being considered by the city. Address the Mayor.

GAINESVILLE, GA.—A company has been formed by leading citizens of this place to build an electric railway in this city and to extend it to East Gainesville. The company has applied to the City Council for a charter. Dr. Andrew Sledd, president of the University, is at the head of the proposed company.

SANDPOINT, IDAHO.—Preparations are being made by the Interstate Bell Telephone Company for improvements to its system in this place at a cost of several thousand dollars. The wires now used will be replaced by cables and a new switchboard installed.

ALTAMONT, ILL.—The Effingham County Telephone Company has increased its capital from $6,000 to $8,000.

LIBERTYVILLE, ILL.—The Lake County Telephone Company has increased its capital stock from $10,000 to $25,000.

URBANA, ILL.—The Illinois Traction Company will soon commence remodelling the Urbana electric light plant. L. E. Fisher is general manager.

CONNERSVILLE, IND.—The Connersville Heat, Light & Power Company is installing a 900-hp turbo-generator set.

ALEXANDRIA, IND.—The stockholders of the Alexandria Electric Light & Power Company have decided to enlarge the capacity of the plant.

WORTHINGTON, IND.—The Indiana Water & Light Company has recently changed its street open-arc lamps to alternating-current enclosed arcs. P. M. Berens is manager.

INDIANAPOLIS, IND.—The Board of Public Works has ordered all the electric service wires of the local companies, whether of high or low tension, to be placed under ground at once.

LAFAYETTE, IND.—The Sterling Electric Works of this city have been awarded a contract to install a new switchboard in the local independent company's plant, the consideration being $65,000.

COLUMBUS, IND.—Caldwell & Drake, large structural iron manufacturers, announce that they will enlarge their plant and install a large amount of electric equipment, including a dynamo, engines, etc.

GREENFIELD, IND.—The City Council is considering the necessity for a general overhauling and installation of new machinery in the municipal electric light plant in this city. Frequent breakdowns recently have left the city in darkness.

WABASH, IND.—S. P. Shultz, and other prominent farmers, are promoting a plan to build a dam in the Mississinewa River at Pearsons Mill, in this county, and also a power plant to furnish electricity to the farmers in that community and several towns nearby.

HUNTINGTON, IND.—The Western Lime Company, of this city, which is operating about 30 plants, announces that it will electrify them all, and that all machinery and other apparatus in the different plants will be operated by electricity. H. E. Martin is president of the company.

MUNCIE, IND.—The Central Union Telephone Company is contemplating additional improvements to its system in this city within the next few months, which will involve an expenditure of $100,000. The recently installed underground conduit system will be completed and all the lines in the residence and outside districts will be rebuilt.

FREMONT, IA.—The Farmers' & Traders' Telephone Company has been granted a franchise in this place.

BELMONT, IA.—The citizens are considering the question of erecting an electric lighting plant in this place.

WICHITA, KAN.—The Wichita Gas, Electric Light & Power Company is enlarging its electric light plant and reconstructing its system.

FALMOUTH, KY.—W. E. Wilson, city clerk, writes that the Falmouth Electric Light Company has secured the franchise for an electric light and power plant.

LEXINGTON, KY.—The Lexington & Interurban Electric Company has under consideration the extension of its lines to the adjoining Central Kentucky towns, and other extensive improvements which will involve an expenditure of about $2,000,000. R. T. Gunn is general manager.

AMITE CITY, LA.—The Central Light & Power Company, which was recently incorporated, has bought out all the rights and privileges of the Tangipahoa Light & Power Company. The Board of Directors is composed of H. P. McClendon, W. B. Senter and Charles B. Pierce, with H. P. McClendon, president; W. B. Senter, secretary, and Charles B. Pierce, vice-president.

NEW ORLEANS, LA.—The Baton Rouge electric light, gas and street railway system has been purchased by New Orleans, Boston and Baton Rouge capitalists for $150,000. The lighting system and street railway system of Baton Rouge will be transferred to a corporation soon to be formed. The parties behind the deal have secured a charter for an electric railway between Baton Rouge and New Orleans, which will soon be built. It is rumored the same parties are trying to secure the plant of the Consumers' Electric Light Company.

MADISON, ME.—The citizens are considering the question of purchasing another generator for the municipal electric light plant.

HAGERSTOWN, MD.—The Hagerstown Spoke & Bending Company, of Hagerstown, is in the market for a dynamo of about 250-light capacity.

BALTIMORE, MD.—The United Railways & Electric Company is contemplating the construction of several new suburban lines, which will add 32 miles of track to its system. The new work will be done by the Maryland Electric Railways Company, which was organized for the purpose of providing car barns and feeders, to be leased to the United Railways Company.

BOSTON, MASS.—The Board of Aldermen, on November 19, declared in favor of municipal ownership of gas and electric light plant.

SOUTH DEERFIELD, MASS.—The electric lighting system in town, now supplied with electricity from the plant at J. B. Bridges & Co., will soon furnish a 24-hour service and will secure electric energy from the Amherst & Sunderland Electric Light Company.

GARDNER, MASS.—In addition to the 210-kw dynamo recently installed, the Gardner Electric Light Company has purchased a 190-kw direct-current generator of 500 volts, to be used for power purposes. The new machine will be installed in about two months.

QUINCY, MASS.—The Quincy Electric Light & Power Company has filed a petition with the Board of Gas and Electric Light Commissioners for authority to issue additional capital stock to the amount of $50,000, the proceeds to be used for the payment of floating indebtedness.

ARLINGTON, MASS.—The committee appointed to investigate and report on the matter of a municipal electric light plant has asked for more time and an additional appropriation of $750 for expenses. When the matter came for action so much opposition developed that the question has been dropped for the present.

COTTAGE CITY, MASS.—At a special town meeting held Nov. 20 the citizens voted to appoint a committee, consisting of David J. Barney, Clofus L. Gonyon and the three selectmen, to contract with the Cottage City Gas & Electric Light Company for lighting the town for a term of years not exceeding five, and not to exceed the sum of $3,500 per year.

READING, MASS.—At a special town meeting held Nov. 12 to decide on the question of issuing $25,000 in bonds for reconstructing and enlarging the electric light plant, a committee of five was appointed to conduct an investigation and employ an expert to decide as to the condition of the plant. The committee consists of Edward H. Palmer, Frank F. Strout, Gilman L. Parker, William H. Byers and John F. Turner.

CHICOPEE, MASS.—The special committee appointed to investigate the condition of the municipal electric light plant made its report to the Board of Aldermen, Nov. 19. The report recommends that all bills of the plant be paid by the city treasurer; that new arc dynamos be purchased, and open-arc lamps be installed; that the item of extraordinary repairs be included in the repair account in the future; that an electric light commission of three members to have charge of the department be appointed by the mayor for terms of three years; also that a special effort be made to increase the commercial business of the plant. With the improvements and changes suggested and the acquirement of new business the plant can be put on a paying basis.

IRON MOUNTAIN, MICH.—Alfred Glass has secured a franchise to install an electric system in this place.

WAYLAND, MICH.—A franchise has been granted to S. Phelps, of Chicago, Ill., to operate an electric light plant in this place.

STEPHENSON, MICH.—T. F. Goulder and Michael Durocher, of Menominee, are interested in the construction of an electric light plant.

ISHPEMING, MICH.—The Marquette County Gas & Electric Light Company is preparing plans for enlarging and remodeling its plants. A. B. Tinch is manager.

MIDLAND, MICH.—Work will commence about April 1 on the construction of the Edenville dam in which Frank S. Wixon, of Detroit; L. E. Rowley, of Lansing, and others are reported interested. About 5,000 hp will be developed.

GREENVILLE, MICH.—The Grand Rapids Electric Railway Company, which has surveyed a line of railway from Grand Rapids to Greenville, Mount Pleasant and Alpena, has filed in Stanton and in different counties along the right of way a trust deed to the Cleveland Trust Company for money for construction purposes.

LANSING, MICH.—The Commonwealth Power Company has begun the construction of its transmission line from this city to power plant, which is now in the process of construction near Lyons, a distance of about 40 miles. The plant when completed will have a capacity of 4,000 hp and will furnish electric power to operate the local and interurban railways in this city, and will also furnish electricity to Jackson, Battle Creek and Kalamazoo.

DEER RIVER, MINN.—It is reported that a company will be organized to install an electric light and telephone system in this place.

TRACY, MINN.—The citizens have voted to issue $12,000 in bonds, for improving the water works and lighting plant.

NATCHEZ, MISS.—The Board of Aldermen has instructed the city solicitor to prepare an ordinance requiring the telegraph, telephone and electric light companies to place their wires underground.

NATCHEZ, MISS.—It is reported that the city will shortly ask for bids for a 5-year and 10-year contract for public lighting. The bids are to be returned in March, 1907, the contract to become effective in March, 1908. The contract will call for not less than 115 arc lamps of not less than 2,000 cp each. At present the city has 117 arc lamps, 2 incandescent lamps and 10 series lamps, as well as the lamps for all public buildings, which includes the engine houses. The contract expires in March, 1908.

ALBA, MO.—G. C. Adams and E. W. Hesser, of Carthage, have secured a franchise for an electric light plant at Alba.

GRANBY, MO.—H. Campbell Joplin writes that the proposed water works and electric light plant, of which he is consulting engineer, and which will be constructed at Granby, will cost between $20,000 and $30,000. Bids will be received in about 60 days. All communications should be addressed to him.

MEMPHIS, MO.—The Iowa-Missouri Power & Traction Company has financed and is about ready to begin the construction of an interurban railway from Fairfield, Ia., to Memphis, Mo., and intends constructing a southern extension from Memphis to Mexico, Mo.; also a northern extension from Fairfield to Cedar Rapids, Ia. The distance now ready for construction is 52 miles. J. W. Andrews is the engineer.

BUTTE, MONT.—The Butte Electric Railway Company is contemplating extending its South Butte line to the new Gallitin addition in the spring.

OMAHA, NEB.—The Omaha Electric Light & Power Company has purchased two lots on Auburn hill, on which it will erect a sub-station in the spring, at a cost of $10,000.

SOUTH OMAHA, NEB.—The City Council has granted a franchise to the Omaha & Southern Interurban Railway for an electric railway within the limits of the city.

SEWARD, NEB.—A Kenney water-tube boiler has recently been installed in the municipal electric light plant. The municipal plant cleared last year above expenses $3,100.

FREMONT, NEB.—L. D. Richards, Secretary Board Water & Light Commissioners, writes that the proposed water works and electric light improvements will cost $75,000. C. A. Chapman, Monadnock Building, Chicago, Ill., is engineer.

OMAHA, NEB.—The Independent Telephone Company, of Omaha, has let a contract for the construction of an automatic telephone system in Omaha, involving an expenditure of $1,500,000, to the Crescent Construction Company, of Portland, Ore. A franchise was voted the Independent Company at the November general election.

TONOPAH, NEV.—The Nevada Power, Mining & Milling Company is contemplating an expenditure of $400,000 in extending its transmission lines to the Bullfrog mining district, a distance of 90 miles. C. O. Poole is chief engineer.

RENO, NEV.—Senator Newlands, Senator George S. Nixon, P. L. Flanigan, Herbert Fleishhacker, T. B. Rickey, James Dunn and others are said to be forming a company to construct an electric railway to Lake Tahoe. One million dollars has been already subscribed.

PERTH AMBOY, N. J.—The directors of the Citizens' Electric Light, Heat & Power Company are contemplating doubling the capacity of the present plant.

WOODBURY, N. J.—John E. Estell, city clerk, writes that the citizens voted November 6 to construct a municipal electric light plant, but nothing definite has yet been done.

TRENTON, N. J.—Bids will be received until Dec. 4 by the Common Council for the construction of an extension of the underground cable system to engine house No. 7, and equipment of same with fire alarm apparatus, and the extension of the police patrol system and equipment of seven patrol boxes. Harry B. Salter is city clerk.

ROCKAWAY, N. J.—The borough of Rockaway has decided to purchase the plant and wires of the Rockaway Electric Light & Power Company and operate it as a municipal electric light and power plant. The amount paid for the plant is $19,000. About 5,000 will be needed for improvements, which will bring the total cost to the borough up to about $25,000. It is expected that the transfer will be made about January 1.

BINGHAMTON, N. Y.—A storage battery is being installed in the power station of the Binghamton Railway Company.

RAVENA, N. Y.—A franchise has been granted to the West Shore Electric Company to furnish electricity for lighting in this town.

SCHUYLERVILLE, N. Y.—The General Electric Company, of Schenectady, it is reported, has purchased the Victory Mills property in this place and will construct a power house here.

FAIRPORT, N. Y.—The question of purchasing additional dynamo and engine for the municipal lighting and power plant is under consideration and is to be submitted to a vote of the people.

LITTLE FALLS, N. Y.—The Council has granted a franchise to the Hudson River Electric Power Company to do a general electric business in Little Falls. C. E. Parsons is chief engineer.

ALBANY, N. Y.—Mayor Gaus will have presented to the Legislature bills lowering the price of gas and electricity, gas to be $1 per 1,000 cubic feet and electricity to be 10 cents per kw-hour.

BROOKLYN, N. Y.—Bids will be received until Dec. 3 by C. B. J. Snyder, superintendent of school buildings, New York City, for installing electric equipment in School 148, Borough of Brooklyn.

FULTON, N. Y.—The Oswego River Power Transmission Company has filed an application for a franchise to construct a system in this city for the purpose of transmitting electricity for heat, light and power.

COEYMANS, N. Y.—The West Shore Electric Company has been granted a franchise by the Town Board to furnish electricity for lighting in the town. The company will erect a station in this place. A franchise has also been granted to the company in Ravena.

NEW YORK, N. Y.—It is stated that the Pennsylvania Railroad Company will build an independent electric railway between New York and Elizabeth, which is to be part of the general plan to reorganize the passenger service when the Hudson River tunnels have been completed.

AMSTERDAM, N. Y.—The Empire State Power Company is contemplating the construction of four additional dams, two with generating stations on the Schoharie Creek in the vicinity of Burtonville. It is also stated that the company intends constructing a storage plant at the upper valley of the river. C. M. Knight is superintendent.

SYRACUSE, N. Y.—A bill is being prepared by Mayor Alan C. Fobes to permit competitive bidding for the city lighting contract. The bill, if passed by the Legislature, will amend the charter for cities of the second class so as to make it unnecessary for a prospective bidder to first erect a plant and secure a franchise from the Common Council.

BUFFALO, N. Y.—The New York Securities Company, recently incorporated at Buffalo, N. Y., with a capital of $2,500,000, has taken over the charter of the Economic Power & Construction Company, granted in 1893, with rights to lay transmission tubes for electric power and lighting, telephones and steam heating and refrigeration. It is the purpose of the company to operate in Buffalo a system of heat, power and light distribution from a central station which it will build.

ILION, N. Y.—The citizens are agitating the question of purchasing electricity to be delivered at the municipal electric light station to operate the electric lighting system. The Board of Electric Light Commissioners has advertised for bids for electric energy to be delivered at the municipal power house. The municipal plant is now a paying institution, but as electricity can be purchased at a lower rate than it can be generated at the station, it is thought that more money can thus be saved. The present plant will be reserved for use in case of emergency.

CANASTOTA, N. Y.—There is much indignation among the citizens in this place at the service which the electric light company is furnishing. The Madison Gas & Electric Company, of Oneida, has the contract for lighting the streets of the village and also a franchise for furnishing commercial lighting. For the past three weeks the streets have been in darkness and the commercial service has been discontinued. It is said that the company can only furnish sufficient energy to operate the Oneida street railway and the electric lighting system in that city.

LA GRANGE, N. C.—Dr. J. M. Hodges proposes to install a lighting plant in this town.

DAYTON, OHIO.—The South Park Railway Company has been granted a franchise to extend its lines to the plant of the National Cash Register Company.

CLEVELAND, OHIO.—An increase of capital stock from $75,000 to $100,000 has been made by the Rocky River Water, Light & Power Company of this city.

CLEVELAND, OHIO.—Plans have been completed for a new exchange by the Cuyahoga Telephone Company to be located on East 81st Street, at a cost of $200,000.

PORT CLINTON, OHIO.—The Port Clinton Electric Light & Power Company has secured a franchise to maintain and operate an electric light and power plant.

CLEVELAND, OHIO.—Rights of way have been secured for the Cleveland, Brooklyn & Elyria line between this city and Elyria, and it is stated that bids are being received for the construction.

CLEVELAND, OHIO.—The county building commission has instructed the County Commissioners to lease or purchase land upon which to erect a plant for furnishing heat, light and power to the group plan buildings.

TOLEDO, OHIO.—The City Council has approved the resolution directing the Toledo Railways & Light Company to replace 1,375 arc lamps with lamps of the magnetite type, as provided for under the new electric lighting contract.

YOUNGSTOWN, OHIO.—The Mahoning & Shenango Valley Traction Company is installing new boilers and other additional equipment in its power station at Niles. The company will improve the service on its Leavittsburg Division as soon as the changes are made.

WARREN, OHIO.—The committee appointed by the village council to investigate the advisability of purchasing the local light and water plants, has reported that the price is too high. The company asks $400,000 for the plants. The committee stated that the plants could be duplicated at half that figure.

LAKEWOOD, OHIO.—At a recent meeting of the City Council, a committee was appointed to confer with the Cleveland Electric Illuminating Company to ascertain at what price it would purchase the municipal electric light plant. The committee consists of Edward Hobday, N. C. Cotabish and Charles Newell.

CLEVELAND, OHIO.—The Cleveland Telephone Company has plans for a new building for the Glen exchange, which will have a capacity of about 9,600 lines, and will cost $150,000 when fully equipped. Work will be begun on the building shortly. The company is also arranging for a new building for the Marlo exchange.

SALEM, ORE.—It is probable that a bill will be presented to the next Legislature for the erection of an electric plant of sufficient capacity to furnish electric energy for light and power for all the State institutions at Salem.

JOHNSTOWN, PA.—The promoters of the Dale Light, Heat & Power Company have decided to make another application to the City Council for a franchise in this city.

SCRANTON, PA.—The City Council is preparing an ordinance compelling all telephone, telegraph, electric light and power wires to be placed underground within the fire limits in this city.

PHILADELPHIA, PA.—The Reading Railway Company is considering plans for installing an electric suburban service to follow the elevation of its tracks now under consideration in this city.

YORK, PA.—The Delta Water Power Company has awarded contracts for its plant as follows: To Josiah Peeling, of York, for dam across Muddy Creek at Castle Fin, to the Westinghouse Electric & Manufacturing Company, of Pittsburg, for the electrical apparatus, and to the S. Morgan Smith Company, of York, for the hydraulic equipment.

JOHNSTOWN, PA.—The joint highways committee of the City Council has granted franchises to the Johnstown Terminal Railroad Company and the Johnstown & Northern Railway Company. The Arbutus Park Railway Company and the Johnstown & Woodvale Heights Railway Company were recommended for franchises without restriction or remuneration.

EASTON, PA.—Owing to the municipal electric light plant being unable to meet the demands made upon it for lighting purposes, Mayor March has recommended purchasing electric energy from one of the local electric lighting companies until repairs can be made and also recommends the purchase of another dynamo for use in emergencies. B. G. Eckhard is superintendent.

NEW CASTLE, PA.—The stockholders of the New Castle & New Wilmington Railway Company, which proposes to construct an electric railway between the two places, have effected a permanent organization, with the following: J. H. Veazey, president; J. J. Ashenhurst, secretary, and G. H. Getty, treasurer. It is expected construction work will begin early in the spring.

STROUDSBURG, PA.—The Citizens Gas & Electric Light Company is installing the new enclosed-arc lamp system. The power station is also being enlarged and improved to provide for operating the new system. The Citizens Gas & Electric Light Company has announced an increase ot pay to its outside men amounting to about 13 per cent. John Harbaugh is superintendent.

JOHNSTOWN, PA.—W. E. Hildebrand, general manager of the Johnstown, Ebensburg & Northern Railroad, writes that it is the purpose of his company to begin awarding contracts early in January and commence active construction of the road in the spring. Mr. Hildebrand adds that the company is now anxious to receive information from the different manufacturers, contractors, etc., who do work and supply material for new railways.

GETTYSBURG, PA.—The Chambersburg & Gettysburg Electric Railway Company has acquired control of that portion of the Gettysburg & Chambersburg Turnpike between this place and Cashtown, a distance of about 20 miles, and also the control of the Littlestown & Gettysburg Turnpike, a distance of 11 miles. This change of owners means the extension next summer of the line of the Chambersburg & Gettysburg Company from Caledonia to Gettysburg and the building of a line from Gettysburg to Littlestown, at which latter place connection would be made with the extension of the York County Traction Company, now being built.

SCRANTON, PA.—It is reported that all the holdings of the Suburban Electric Light Company have been taken over by the Electric Light Company of America. These holdings include the Suburban Electric Company, the Dunmore Light, Heat & Power Company, the Scranton Illuminating Company and the Priceburg and Dickson City Electric Light Companies. The companies are capitalized at $1,200,000. All of the electric light and power companies are included in the deal, except the new Lackawanna Light Company. It is understood that the transfer of the management and control of the Scranton companies goes into effect at the beginning of the year.

WARWICK, R. I.—The citizens have voted to appropriate the sum of $15,000 for electric lighting in the town.

KINGSTON, R. I.—The new electric lighting plant at the Rhode Island State College has been put in operation. The equipment of the plant consists of a 50-kw alternating-current generator, a 60-hp Corliss engine and two boilers having a capacity of 100 hp each. The plant furnishes electricity for lighting the college buildings, the South Kingston jail and the County Court House. New arc lamps will be installed at the college entrance and in the gymnasium. It is expected that electric motors will be installed to take the place of the engines now in use in the shops and college laundry.

GAFFNEY, S. C.—The Piedmont Telephone & Telegraph Company, of Gastonia, has purchased the plant and system of the Gaffney Telephone Company.

CONWAY, S. C.—Robt. B. Scarborough, president of the Board of Commissioners of Public Works, writes that the contract has not yet been let for the construction of the electric light plant.

FAYETTEVILLE, TENN.—The Fayetteville Street Railway & Power Company has decided to begin construction immediately.

HIGH POINT, TENN.—The city is considering the installation of an electric light plant, and a committee has been appointed to estimate the cost.

JOHNSON CITY, TENN.—The Electric Light & Water Works Company has changed its name to Johnson City Electric, Gas & Water Company, and increased its capital stock from $10,000 to $50,000.

GLEESON STATION, TENN.—W. H. Williams, general manager Gleeson Water & Light Company, writes that probably some time next year bids will be received for the construction of an electric light plant.

CHATTANOOGA, TENN.—The installation of a 500-kw steam turbine at the plant of the Chattanooga Electric Light & Power Company has just been completed. Another machine of 1,000 kw capacity will be installed in December, when the company will be able to meet the increased demands made upon it for electricity for light and power. B. T. Burt is general manager.

CHILDRESS, TEX.—The City Council has passed an ordinance granting Paul J. Robertson and his associates a franchise to operate an electric light and power plant in this city for a term of 30 years.

DALLAS, TEX.—The contract for the construction of the proposed J. Mercer Carter interurban line has been placed with the American Engineering Company, of Indianapolis, Ind. C. N. Wilson is president of the American Engineering Company.

NEWPORT, VT.—It is reported that Charles A. Prouty has purchased the Spaulding pulp mill property and will utilize the extra power for his electric light plant.

PULASKI, VA.—The Council is considering the question of constructing a municipal electric light and power plant.

WINCHESTER, VA.—The Winchester & Washington City Electric Railway Company has secured a through right-of-way for its electric railway from Millville to Winchester.

SUFFOLK, VA.—James L. McLemore, president of the Suffolk Gas Company, writes that the proposed gas and electric light plant will cost $90,000. J. O. Barham is the engineer.

MANCHESTER, VA.—Surveys are being made for a new electric railway from Manchester to Midlothian. The road will be capitalized by a local syndicate, and will shortly apply to the Corporation Commission for a charter.

CLARKSTON, WASH.—The City Council has given instructions that several more arc lamps be added to the city street lighting system. The Lewiston-Clarkston Company has the contract for city lighting.

WALLA WALLA, WASH.—Owing to the recent heavy rains the plant of the Northwestern Gas & Electric Company has been put out of commission. The company furnishes electricity in Pendleton, Walla Walla, Athena and other towns along its lines, which places will be in darkness until the plant can be repaired.

PUYALLUP, WASH.—The Puget Sound Electric Power Company has applied to the City Council for a franchise in this city for its proposed electric railway from Tacoma to Puyallup. The proposed road will cost $500,000. The Tacoma Railway & Power Company is to erect a substation in this city, which is expected to be in operation by the early part of next year. W. S. Dimmock is manager of the Tacoma Railway & Power Company.

GRAFTON, W. VA.—The Grafton Electric Railway Company is contemplating extending its lines a distance of two and one-half miles.

MILWAUKEE, WIS.—H. S. Bowen, of Chicago, has been appointed superintendent of construction for the proposed municipal electric light plant here.

WASHBURN, WIS.—W. A. Robinson, city clerk, writes that the citizens voted on Nov. 6 to construct a municipal electric light plant. Bids have not yet been called for.

SARATOGA, WYO.—The Saratoga Light, Heat & Power Company is preparing to rebuild its plant, which was recently destroyed by fire. It is hoped to have the plant in operation within three months.

MONTREAL, CAN.—The Saraguay Electric Light & Power Company, which recently made an offer to supply light to the citizens of Montreal, has taken over the property of the Cartierville Electric Light & Power Company and has secured the contracts for lighting the towns of St. Laurent and the village of Bordeaux. The directors not only ask to be allowed to enter Montreal, but are considering plans for extending its operations throughout the entire island of Montreal. The directors of the company are: W. M. Ramsay, president; Hon. Lomer Gouin, vice-president; E. Champagne, managing director; W. R. Cunningham, secretary-treasurer; Charles Branders, chief engineer, and August W. Hooper. The announcement is made that the company will make application at the next session of the Quebec Legislature for power to increase its capital from $250,000 to $1,000,000.

CITY OF MEXICO, MEX.—A. B. Brown, president of the Los Grados Mines, Inc., has applied for a concession for waters from the Balsas River, to be used in generating electric power to operate mining machinery and other industries.

CITY OF MEXICO, MEX.—A petition has been presented by the Citizens of Ocotlan, Oaxaca, to have an electric light plant installed, several influential citizens being behind the project.

FREDERICK, N. B.—James Burgess, of Grand Falls; J. F. Tweeddale, of Arthurette, and J. E. Stewart, of Andover, have given notice that they will make application at the next session of the Legislature for the incorporation of the St. John & Grand Falls Electric Railway Company for the purpose of constructing an electric railway from St. John to Fredericton, thence to Grand Falls and to the boundary line of the State of Maine.

BROCKVILLE, ONT.—In reply to an application for figures on 500 and 1,000 hp made by the town of Brockville, the Hydro-Electric Power Commission gives an estimate for power as follows: 1,000 hp at $25 per hp, including 30-year sinking fund. This price covers a 20-hour service. No price was given for 500 hp. The matter will be taken up at the next meeting of the Town Council, together with another proposition for transmitting electricity to this place.

MONTREAL, QUE.—The directors of the San Paulo Company propose to increase the capital stock for the purpose of making extensions to its power plant. More generators will be installed and its transmission lines extended.

NOTRE DAME DE GRACE, QUE.—The Council of Notre Dame de Grace has awarded the contract for supplying 100 incandescent lamps for street lighting to the town of Westmount, which has a municipal plant. The contract price is $35 a lamp.

Company Elections.

PITTSFIELD, MASS.—At the annual meeting of the Berkshire Street Railway Company the following directors were elected: C. S. Mellen, C. F. Brooker, D. Newton Barney, William Skinner, Robert W. Taft, Nathaniel Thayer, Edwin Miner, R. D. Gillett and H. W. Ely.

JOHNSTOWN, PA.—At the annual meeting of the Citizens' Light, Heat & Power Company, held recently, the following directors were elected for the ensuing year: Charles S. Price, James G. Ellis, Scott Dibert, William R. Thomas, Joseph Morgan, James Quinn, Charles F. Kress, Joseph Friedhoff, John H. Waters and John D. Roberts. Later the board met and re-elected Charles S. Price, president; James G. Ellis, vice-president, and Curtis G. Campbell, secretary and treasurer.

FOND DU LAC, WIS.—The Milwaukee & Fox River Valley Railroad Company, recently incorporated, has elected the following officers: Dr. George Brickhauer, Elkhart Lake, president; W. H. Phillips, Fond du Lac, vice-president; R. H. Crosby, Fond du Lac, secretary; Dr. A. J. Pullen, North Fond du Lac, treasurer; J. M. Seaman, Sheboygan, general manager.

New Industrial Companies.

THE AUSTIN SMITH ENGINEERING COMPANY, of Baltimore, Md., has been incorporated, with a capital of $50,000, to manufacture and deal in mechanical and electrical specialties.

THE ELECTRIC CITY PUBLISHING COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $10,000, by Herbert A. Seymour, John F. Gilchrist and William A. Fox.

THE ELECTRIC SHOP, of Evanston, Ill., has been incorporated to manufacture electric appliances by W. E. Edwards, H. D. Payne and H. G. Zaber. The capital stock of the company is $2,500.

THE INVINCIBLE ELECTRIC BANK PROTECTION COMPANY, of Cedar Rapids, Ia., has been incorporated, with a capital stock of $120,000, of which $500 is represented by business and property in Wisconsin. W. I. Noel, of Monroe, is Wisconsin representative.

New Incorporations.

WICHITA FALLS, TEX.—The Citizens' Electric Light Company has been organized with J. D. Avis, president, and E. P. Walsh, secretary. A charter has been applied for.

CORPUS CHRISTI, TEX.—The Corpus Christi Ice & Electric Company has filed articles of incorporation with a capital stock of $65,000. The incorporators are E. A. Brown and others.

CLEVELAND, TEX.—The Cleveland Telephone Company has been organized with a capital stock of $1,000. J. T. Tanner has been elected president and manager; R. W Jeffers, secretary, and T. A. Booth, treasurer.

WEATHERFORD, TEX.—The Weatherford Gas, Light, Heat & Power Company, with a capital stock of $50,000, has been incorporated by G. M. Bowie, C. C. Barthold, G. S. White, J. H. Prince, all of Weatherford, and W. H. McGoldrick, of San Antonio.

BURKVILLE, TEX.—The Western Union Telephone Company has filed articles of incorporations, with a capital stock of $20,000. The company proposes to operate a telephone line in several counties in East Texas. The incorporators are: E. F. Montgomery, J. C. Ramsey, J. S. McWhorte and others.

RICHFIELD, UTAH.—The Richfield Electric Light and Power Company has been incorporated, with a capital of $50,000. The officers are Thomas Brown, president; William H. Seegmiller, vice-president and general manager; James M. Peterson, treasurer; John Hood, secretary. H. N. Hayes, James Christiansen and the officers compose the board of directors.

OGDEN, UTAH.—Articles of incorporation have been filed for the Ogden Gas, Light & Fuel Company, with a capital stock of $500,000. The company will manufacture and supply gas, electricity and steam to municipalities, corporations and individuals for light, heat and power purposes in Ogden and elsewhere. The officers are A. T. Wright, president; R. E. Hoag, vice-president; F. B. Stevens, secretary and treasurer. The officers with J. F. Grant, Jr., and R. T. Harris form the board of directors.

CHRISTIANSBURG, VA.—The Montgomery Traction Company has been chartered, with a capital of $10,000, for the purpose of building an electric railway from this city to Cambria, a distance of 2¼ miles. C. A Johnston is president and H. M. Tompkins, secretary.

LURAY, VA.—The Farmers Mutual Telephone Company has been chartered with a capital stock of $5,000. The officers are D. S. Hite, president; Isaiah Printz, vice-president, and A. M. Beach, secretary and treasurer, all of Luray.

SPOKANE, WASH.—The Empire Electric Company has been incorporated with a capital stock of $25,000 by A. C. Rice and others.

SPOKANE, WASH.—The Trent Power & Irrigation Company has been incorporated with a capital of $15,000, by Frank MacKeen and H. W. Wright.

TACOMA, WASH.—The Coos Bay Gas & Electric Company has been incorporated with a capital stock of $250,000 by Henry Hewitt, J. J. Hewitt and others.

RENTON, WASH.—The Independent Telephone & Telegraph Company has filed articles of incorporation with a capital stock of $10,000, by A. T. West and others.

WAHL, WASH.—The Silver Lake Telephone Company has filed articles of incorporation with a capital stock of $2,000. The incorporators are George Hemme and others.

PROSSER, WASH.—The Prosser Traction Company has filed articles of incorporation with a capital stock of $150,000. The incorporators are Frederick Finn, J. W. Callicotte, G. A. Todd, George B. Boomer and F. A. Jenne.

OLYMPIA, WASH.—The Chehalis-South Bend Electric Railway Company has been incorporated for the purpose of building a steam or electric railway from South Bend to Chehalis. It is capitalized at $150,000. The incorporators are: W. S. Cram, Jacob Siler, T. H. Donovan, of Raymond; S. L. Hyman, F. G. and H. G. Shoemaker, of South Bend, and Walter G. Hyman, of Burlingame, Cal.

SOUTH BEND, WASH.—The Pacific & Eastern Railway Company has been incorporated for the purpose of building an electric or steam railway from South Bend to Chehalis. The company has a capital stock of $150,000. The incorporators are W. S. Cram, Jacob Siler and T. H. Donovan, of Raymond; S. L. Hyman, F. G. and H. G. Schoemaker, of South Bend, and Walter G. Hyman, of Burlingame.

PALOUSE, WASH.—Articles of incorporation have been filed with the Secretary of State for the Palouse Light & Power Company, of which D. G. Klinefelter is president and manager, and Clara Klinefelter, vice-president. The transmission line of the Washington Power Company has been completed to this city and connected with the system of the Palouse Light & Power Company. The local company is now prepared to supply electric energy in any quantity for manufacturing purposes.

CHARLESTON, W. VA.—The Longdale Independent Telephone Company has filed articles of incorporation with a capital stock of $15,000, to build and operate a general telephone system through West Virginia. The incorporators are C. B. Rickard and others.

KEYSER, W. VA.—The Mineral County Division of the West Virginia Mutual Telephone Association has been organized here with the following officers: J. W. Carskadon, president; J. W. Wagoner, secretary and treasurer. The company will operate a line from Keyser to Petersburg, where it will connect with the Mutual Telephone systems of Pendleton and Hardy counties.

SULLIVAN, WIS.—The Sullivan Telephone Company has been incorporated with a capital of $10,000.

MILWAUKEE, WIS.—Articles of incorporation have been filed for the Battery Light & Power Company by Frank Gregory and others.

FOND DU LAC, WIS.—The Milwaukee & Fox River Valley Railway Company has filed articles of incorporation with a capital stock of $25,000.

MILWAUKEE, WIS.—The Milwaukee Western Electric Railway Company has filed articles of incorporation with a capital stock of $5,000. The incorporators are George W. Schermuly, H. J. Janzer and William Ross.

MADISON, WIS.—Articles of incorporation have been filed for the Madison & Fond du Lac Electric Railway Company. The present capital stock is $150,000, which will eventually be increased to $3,000,000. The company will build an electric railway between Madison and Fond du Lac, operated by the third rail system. A line will also be built from Watertown and Fox Lake, crossing the main line at Beaver Dam, where the power house will be located. A survey has been completed and the right-of-way is now being procured, and contracts for the construction have been let.

NEWCASTLE, WYO.—The Newcastle Electric Company has filed articles of incorporation with a capital stock of $30,000.

JACKSON, WYO.—A certificate of incorporation has been filed with the Secretary of State for the Jackson Valley Telephone Company by S. N. Leek, Abraham Ward, J. A. Adams, Fred Lovejoy and W. W. Smith. The company has a capital stock of $5,000.

WATERFORD, ONT.—The Norfolk County Telephone Company has been organized with a capital stock of $40,000. The head office will be at Waterford.

WELLAND, ONT., CAN.—The Welland Electrical Company has been incorporated with a capital of $175,000, to manufacture electricity for light, heat and power purposes. The charter members include: W. E. Phin, M. McAuliff, W. M. German, all of Welland, Ont.

Legal.

REGULATING TELEPHONE RATES.—At Louisville, Ky., on November 18, Federal Judge Evans granted the Cumberland Telephone and Telegraph Company (the Bell Company) a temporary restraining order preventing the city from enforcing an ordinance recently passed by the council and signed to-day by Mayor Barth, regulating telephone charges. The Home Company, independent, is not affected by the measure, as its rates are lower. The suit filed charges that the city is virtually seeking to confiscate property, as the prices fixed are too low, it is said, to allow the company to operate at a sufficient profit on its investment. Protection is sought under the fourteenth amendment.

DISCRIMINATION IN TELEGRAPHIC MESSAGES.—Sections 5511 and 5512 of Burns' Annotated Statutes of 1901 (Indiana), provide for a penalty of $100 in event any telegraph company, with wires wholly or partly within the State, fails to transmit messages with impartiality and in the order of their receipt or discriminates in the matter of charging therefor. It was held in Western Union Telegraph Company vs. McClellan decided by the Appellate Court of Indiana, that the telegraph company was liable for the penalty, it appearing that six cents more than the regular rate had been charged upon a message and that the delivery of the message, the urgency of which appeared upon its face, was unnecessarily delayed for two hours.

CONTRACT BY CITY TO EXEMPT LIGHTING COMPANY FROM TAXATION INVALID.—The city of Frankfort, Ky., sold a lighting plant which it owned to a company and, as consideration for street lighting, which the company agreed to furnish, the city obligated itself to pay to the lighting company sums equal to the city taxes of every kind which should be assessed against the company. It was held that the contract was void because it was an agreement by the city to exempt the property from taxation in violation of sections 170 and 174 of the State Constitution requiring property not exempt by the Constitution to be assessed at its actual value. It was held, however, that the lighing company might recover for the light furnished upon a *quantum meruit* (so much as the lighting service was reasonably worth). Board of Councilmen vs. Capital Gas & Electric Light Co., Court of Appeals of Kentucky.

DAMAGES FOR FAILURE TO DELIVER TELEGRAM.—Where, because of the failure of a telegraph company to deliver a telegram, the sender was obliged to wait in a livery stable exposed to the cold for four hours, the only damages which he can recover are the cost of the message and of the conveyance which the non-delivery compelled him to hire. The plaintiff's remaining in a disagreeable livery stable for four hours on a cold day is held not to be such a result as could have been within the contemplation of the parties or such as should have been reasonably anticipated by the telegraph company. The same was rather the result of the plaintiff's choice to remain there instead of seeking a more comfortable place. The law requires one who is affected by the neglignce of another to use ordinary care to avert or minimize the harmful consequences. Jones vs. Western Union Telegraph Co., Supreme Court of South Carolina.

INJUNCTION TO RESTAIN TELEPHONE COMPANY FROM OCCUPYING LAND DENIED.—The petition in an action to enjoin a telephone company from maintaining its poles on the plaintiff's property alleged that the telephone line had been erected on the land prior to the plaintiff's purchase of it; that he had never consented to the maintaining of the line upon the property and had requested its removal; that at the time of his purchase there was no contract or other instrument upon record giving the defendant company any right of way or interest in the land; and that the plaintiff had no knowledge of any such right on the part of the defendant. It was held that to invest the company with a right to erect and maintain its poles, it was not necessary that a contract to that effect be recorded and that the failure to record such a writing, if there was any, was immaterial. The petition was dismissed upon the ground that it failed to declare that the occupation of the premises by the defendant was wrongful or without right, the presumption being that the defendant was acting within its rights. Denton vs. Cumberland Telephone & Telegraph Co., Court of Appeals of Kentucky.

COLLISION WITH GUY POLE.—The plaintiff was a member of a volunteer fire company in the city of Mount Vernon, New York, and while standing upon the step of the fire wagon, responding to an alarm, the wagon was driven so near to a pole, belonging to the defendant company and standing near the entrance to the fire house, that he was crushed between the wagon and the pole. The action was brought upon the theory that the defendant was negligent in placing and maintaining its pole in an improper place in the street. The Court stated that, inasmuch as the defendant corporation had municipal authority and right to erect its poles in the streets for the proper conduct of its business, the location of the poles could not be held to be a nuisance or a wrongful obstruction. It was held that the evidence might warrant a jury in finding the defendant guilty of negligence in erecting its pole too near a driveway over which it ought to have known that vehicles were driven with great rapidity and that, therefore, the question of negligence should have been submitted to the jury.—Lambert vs. Westchester Electric Railroad Company, Appellate Division of the Supreme Court of New York.

DEATH FROM WIRE CONTACT.—In the case of Connell vs. Keokuk Electric Railway and Power Co., decided by the Supreme Court of Iowa, it appeard that a boy, fourteen years of age, entered the premises of another without invitation and as a mere licensee, for the purpose of obtaining zinc, which had been thrown away and was lying upon the ground. The defendant company's wires were strung across the premi-

ses and were, in general, insulated, but the deceased, in some way, came in contact with the wire at a point where it had been allowed to sag and where insulation had been worn off, apparently by rubbing against a tree. There was evidence that the defendant knew of the dangerous condition of the wire and knew also that persons were in the habit of going near the place of danger. The fact that the deceased was on the premises as a bar licensee affects only the liability of the owner of the premises. He is under no obligation to maintain his property in a safe condition for the benefit of bare licensees, intruders or trespassers going thereon for their own purposes or pleasure, however laudable their object in so doing. But even as to trespassers, upon property not belonging to it, the defendant is charged with the duty of not wilfully or wantonly imperiling their safety and the defendant was held liable notwithstanding that there had been no wrongful intention on its part.

MUNICIPAL NEGLIGENCE.—Where a municipal corporation is negligent in the operation of an electric lighting plant, maintained for the purpose of illuminating streets, and the negligence results in the death of a person, the municipality is liable for damages. In this case the deceased was killed upon his own premises by coming in contact with a live wire belonging to the city of Columbus, Ind., which had fallen from its pole in an adjoining street, and which formed part of a system of lighting operated under the authority of statutes of the State. It is a general rule of law that municipalities are not responsible for negligence in connection with duties that are purely governmental in their nature, such, for instance, as the duties which municipalities perform with respect to the public health, or schools, or in the protection of property from destruction by fire. In these matters cities enjoy the same immunity from liability for tort as does the State. But, when a municipal corporation is acting in its ministerial or private capacity, for its own advantage or emolument, it is liable for its negligences in the same manner as a private corporation. The plaintiff here, however, was not allowed to recover for the reason that his complaint was defective. The complaint set forth that the fall of the wire was the proximate cause of the death and that the wire had become weak and rotten, in which respect the defendant was charged with negligence, but there was no allegation, as there should have been, that the wire fell by reason of its defective condition. Aiken vs. City of Columbus, Supreme Court of Indiana.

EXPLOSION OF MOTOR; EMPLOYER'S LIABILITY TO SERVANT.—An interesting case involving the employer's liability and the fellow-servant rule has recently been decided by the United States Circuit Court of Appeals. The defendant, a foundry company, was engaged in a large manufacturing business, having a plant of several buildings and maintaining a car shop department and a foundry. Brinkman, the plaintiff, was employed in the car department as night engineer. He had charge of three engines and was employed directly under the orders of the chief engineer. The plaintiff was injured by the explosion of an electric motor in a place apart from his engine room while performing unusual duties under the direction of the chief engineer. The motor had been obtained several months previous to the accident in which the plaintiff was injured and, while awaiting installment, had been left in the engine room, which was thereafter flooded. The testimony was inconclusive as to whether the motor was free from water but tended to establish that the explosion which took place was due to dampness. The chief engineer, in testing the motor before putting it into service, called upon the plaintiff, who had had no experience in electricity and electrical apparatus, to assist him. The plaintiff was directed to watch the voltmeter and took no part in the operation of the motor. The chief engineer found trouble from heating when the current was turned on, but persisted in the application of the current and thus produced the explosion. The evidence tended to show that he was careless in continuing with the current in the face of well-known indications of defect and ensuing danger. It is a doctrine, elementary at common law, that a servant assumes the ordinary risks incurred in the line of his service from the negligence of fellow-servants, when the master is without fault in their employment and their retention in service. It is further established by a long line of decisions that the fellow-servant class includes employes in the "same general undertaking" of the master, irrespective of their grade of service. So, it would seem, the chief engineer, and his subordinate, the plaintiff, were unquestionably fellow-servants. Another rule, equally well established, is that it is the duty of the master to furnish appliances, reasonably safe for the use of his servants. He must provide such appliances as, with reasonable care, can be used without danger save such as is incident to the business in which such instrumentalities are employed. These duties may not be foregone and, when delegated to be performed by another, that other is a vice principal and represents the principal (the master) so that his act is that of the principal. The vice principal may have a dual character, vice principal with respect to the duty due from the master to the servant and fellow-servant with respect to his cast as a workman. It was held that it was the duty of the defendant foundry company to inspect and test the motor and that, in the performance of that duty, the chief engineer was a vice principal. The defendant was responsible, therefore, for the negligence of the chief engineer in causing the explosion. American Car & Foundry Co. vs. Brinkman.

Obituary.

MR. A. G. MACANDREWS.—Mr. Alexander G. MacAndrews, general superintendent of the General Electric Company, at Harrison, N. J., died on November 21, at his residence Mt. Prospect Avenue, Newark, after two weeks' illness, of typhoid fever. Mr. MacAndrews was born in Edinburgh, Scotland, in 1865, and was a graduate of Edinburgh University. He came to this country about twenty years ago, and had been connected with the General Electric Company for a number of years. He is survived by his widow and two sisters. The latter are in Scotland.

Personal.

MR. P. T. HANSCOM.

MR. P. T. HANSCOM has resigned his position as assistant engineer of the General Electric Company in charge of the Power & Mining Department, and associated himself with Messrs. Curtis and Hine, of Colorado Springs. As electrical engineer of this company, Mr. Hanscom will not only have charge of the electrical engineering work, but will also assist in the management of the various hydro-electric plants now being operated or about to be constructed by them. The varied experience which Mr. Hanscom has had in hydraulic power development qualifies him admirably for his new duties. Entering the expert course of the Thomson-Houston Company at Lynn in January, 1893, a year later he took up transmission work under Dr. Louis Bell. In September, 1895, he was transferred to Schenectady, continuing in engineering work of a similar nature in the power and mining department of the General Electric Company, of which Mr. F. O. Blackwell was at that time engineer in charge. Upon Mr. Blackwell's resignation in November, 1904, Mr. Hascom was appointed assistant engineer in charge of the department. The new work in which Mr. Hanscom will be busied for the next two years is of unusual interest. As electrical engineer for the Central Colorado Power Company, he will oversee the development of some 100,000 hp upon the Grand and other Colorado rivers. This power company will have an authorized bond issue of twenty million dollars, the first issue of 9,000,000 having already been subscribed. Unusual engineering features will be involved as the transmission lines cover an area of approximately 50,000 square miles on the Eastern and Western slopes of the Continental Divide, and a transmission potential of about 100,000 volts will be employed. Mr. Hanscom is completing arrangements to start the construction work immediately.

MR. H. C. BARBER, of Pittsfield, Mass., for several years employed by the Stanley Electric Company, has resigned to accept the position of superintendent of the Trumbull Electric Manufacturing Company, of Plainville, Conn.

MR. ROGER A. POOR has just been appointed sales manager of the Bay State Lamp Company, of Danvers, Mass. Mr. Poor will continue his work of writing and illustrating printed advertising, in which field he has attained such merited success.

MR. FRANK C. HACKETT, manager of the Western Union Telegraph office at Cleveland, Ohio, has resigned to take the management of the Ohio Electric Specialty Company, recently organized at Cleveland. The resignation takes effect at once.

MR. J. E. DAVIDSON, general manager of the Consolidated Lighting Company, of Montpelier, Vt., has a very interesting article in the December "Country Life in America," giving an illustrated description of the manner in which electricity is applied to domestic uses in the "home comfortable."

MR. ROBERT McF. DOBLE, of Colorado Springs, formerly of San Francisco, has been retained as consulting and supervising engineer by Messrs. Curtis & Hine, general managers of the recently organized Central Colorado Power Company, in the development of their large hydro-electric power projects on the Grand River, Colorado.

MR. A. R. PARDINGTON, head of the contract department of the Long Island division of the New York and New Jersey Telephone Company, has resigned to accept the position of second vice-president and general manager of the Long Island Motor Parkway, incorporated. The position came to Mr. Pardington unsought. He has been many years a factor in the rapid growth of the telephone system. His active interest in automobiling has led to the present change, which will place him in charge of the great private automobile thoroughfare.

News of the Trade.

A COVERING FOR HEATING SYSTEMS.—Among the many brands of pipe covering on the market for hot water, steam and hot air heating systems, the "Asbestocel" Covering manufactured by the H. W. Johns-Manville Company deserves special mention. This covering is not only an insulator of the highest efficiency, but it is also absolutely fireproof and meets the fire underwriters requirements. It is made entirely of asbestos and is an improvement over the ordinary air-cell coverings, because the corrugations run around the pipe instead of lengthwise, thus effectually preventing all circulation of air and consequent radiation of heat. This

covering is also unusually strong and durable, owing to the fact that it is built on the well-known arch form of construction. "Asbestocel" coverings are proven by actual tests to be capable of paying their initial cost in less than one year by the saving in coal consumption. They are made in sectional form for pipes, in sheets and blocks for large heating surfaces and paper for hot air pipes. The H. W. Johns-Manville Company has recently issued an interesting folder, giving the results of actual tests made on this covering.

THE UNION HARDWARE & ELECTRIC SUPPLY COMPANY, of Providence, R. I., is planning to have a display of calendars in its window as soon after the first of the year as possible which will include all the calendars of the electrical manufacturers and dealers which it can procure. The display will undoubtedly be one which will attract considerable attention and all electrical manufacturers or dealers wishing to be represented therein are invited to send their calendars to the above-named company.

CHICAGO FUSE WIRE.—Mr. W. W. Merrill, secretary of the Chicago Fuse Wire & Manufacturing Company, advises that it has made arrangements with Mr. G. A. Knoche, who was connected with the Wesco Supply Co., St. Louis, for many years as purchasing agent and in other positions of responsibility, to represent the company in the Southwestern States, with headquarters at 539 Frisco Building, St. Louis. He will push the sale of its well-known line of goods, consisting of Union outlet and switch boxes, fuse wire and links and Union enclosed fuses and blocks. The trade will be interested in learning that the Underwriters' National Electric Association has recently approved its line of fuses, National Electrical Code. The company is in a position to ship goods promptly from its Chicago factory.

BLAKE SIGNALS.—The Blake Signal & Mfg. Company, of 246 Sumner Street, Boston, Mass., reports as follows: "The last month we have signed contracts for our signals with various roads in the East and Middle West amounting to over $12,000.00. The interurban roads using a telephone system of train dispatching are beginning to realize what a valuable supplement the Blake signals make to their telephone system, and that our signals are practically indispensable for the proper and safe handling of their traffic. Our signals enable their dispatchers to stop a car at any telephone point for orders, thus saving much time and also adding to the safety of operation. The signals by so successfully supplementing the telephone system of dispatching are making the use of the telephone for dispatching more popular and thereby increasing the demand for telephones for this purpose."

THE AMERICAN ENGINE COMPANY, of Bound Brook, N. J., has recently booked repeat orders, as follows: Three duplex compound engines to the Eli Dupont Co., to be used in its new plant in Toluca, Colo., making the eighth order from this well-known company for American Ball duplex compound engines. One 200-kw generating set, consisting of American Ball generator direct-connected to a duplex compound engine for the American Vulcanized Fibre Company, of Wilmington, Del., this being the third order for duplex compound engines for this company. Three complete generating sets, two of 75-kw and one of 150-kw capacity, driven by duplex compound engines for the Cambridge Gas Light Company, of Cambridge, Mass. The following electrical equipment has been shipped to the W. D. Boyce Company, paper mills at Marseilles, Ill.; two 200-kw, direct-current, 500-volt generators, to be driven by water wheels, and two 125-hp and one 300-hp motors.

Trade Publications.

AIR COMPRESSOR LUBRICATION.—A neat and interesting pamphlet has been issued under this title by the Joseph Dixon Crucible Company, Jersey City. It deals with the value of graphite in such lubrication work and brings out various methods and examples of application in regard to air compressors.

RAILWAY CONTROLLERS.—The Electric Service Supplies Company, Philadelphia, Pa., has issued a well-illustrated bulletin devoted to the "Automotoneer." This electric railway controller is so arranged that the motorman must pause for the desired duration on each controller point whether he be a powerful man or one of less physical strength. These controllers save considerable power and a certain amount of energy during acceleration, and they contribute materially to the satisfactory operation of the equipment.

INTERPOLE MOTORS.—The Electro-Dynamic Company, Bayonne, N. J., has issued, as circular No. 29, a reprint of the paper of Mr. C. H. Bedell on direct-current motor design as influenced by the use of the interpole which was presented at the Milwaukee meeting of the American Institute of Electrical Engineers. The constructive details of the interpole motors are outlined in circular No. 23, and the performance of the machines as viewed by numerous users is strikingly shown in a special publication which contains exact copies of letters from satisfied customers.

BENJAMIN CLUSTERS.—The Benjamin Electric Manufacturing Company, of Chicago, has just issued Catalogue B 17, devoted to its well-known wireless clusters and lighting specialties. The work of this progressive concern has grown to an amazing extent, as illustrated by this handsome catalogue of over 100 pages. The text is divided into several sections, each dealing with a specific line of manufacture and giving precise information; while the excellent engravings are made direct from photographs. A number of new, ingenious and useful devices are listed for the first time.

ADJUSTABLE LAMP HOLDERS.—The Faries Manufacturing Company, Decautur, Ill., has issued Catalogue No. 13 devoted to their adjustable lamp holders, shades, portables, etc., for electric, gas and combination work. It is an oblong pamphlet, of 98 pages, and contains several hundred illustrations with details, data, prices, etc., as to all these useful and universally employed devices. An odd and interesting feature, typical of their work in aluminum, is the aluminum axe shown. The company will be glad to consider inquiries for any kind of castings in this metal that they handle so well.

THE PACIFIC ELECTRIC & MANUFACTURING COMPANY, of San Francisco, Cal., announces with catalogue A that it is prepared to furnish apparatus and appliances for handling electric energy at high potentials on long-distance transmission systems, having acquired the right to manufacture switches under the patents of F. G. Baum. In the catalogue are illustrated a few of the standard types of oil and air-break switches, in use on lines of from 10 to 100 kw, but the company is prepared to furnish designs to meet special conditions. The oil switches are simply and rigidly constructed so as to reduce repairs to a minimum and make the parts readily accessible and easily adjusted or replaced.

BRISTOL GAUGE.—The Bristol Company of Waterbury, Conn., has just published a new gauge catalogue No. 44, which is being circulated among the trade. It has added a large number of ranges to those published in No. 13 catalogue, and several of the old charts have been replaced by modern ones, whose increments are uniform. It has grouped these in the catalogue according to size and capacity, which enables one to find without difficulty the type of instrument best suited for any work. In this is listed the new portable pressure gauge, which is designed for use where permanent installation is not necessary. The Bristol Company will be glad to send these catalogues out to anyone interested on application.

RAILWAY SUPPLIES.—The General Electric Company, Schenectady, N. Y., has prepared an elaborate 233-page catalogue, dealing with railway supplies, which is intended to place in the hands of its customers information that will enable them readily to select repair parts for the maintenance of their equipment and lines, and such other supplies as are best suited to the various requirements in the construction and operation of electric railway systems. The various classes of material are arranged to facilitate the selection of the repair parts most often required, and in each section there is included sufficient descriptive matter for the customer readily to determine the exact materials necessary for his particular work. The catalogue is designated as No. 7601.

THE CENTRAL ELECTRIC COMPANY, of Chicago, has just issued a booklet of 28 pages of "Holiday Suggestions." The cover design is done in three colors and is very appropriate, suggesting as it does the holiday season. The first few pages are devoted to electric reading and desk lamps and many handsome designs are shown, and the next two pages to electric heating devices, the electric chafing dish and flatiron being given prominence. Considerable space is also given to miniature street railways, showing various motor cars, trailers, track and all parts that go to make up a complete street railway. Motors, engines and a motor boat are shown, a learner's telegraph outfit is illustrated and described as well as a complete wireless telegraph outfit. Flashlights, electric clocks and many other electrical novelties are shown, and it is suggested that parties interested write the Central Electric Company for a copy of this booklet. Dealers and central stations will find it interesting and of value as suggesting a large field for doing a nice business among their patrons in this line during the next few weeks.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

American Electro-Therapeautic Association. Secretary, Dr. C. E. Skinner, New Haven, Conn.

American Electrochemical Sociey. Secretary, S. S. Sadtler, 59 S. 10th St., Philadelphia.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty St., New York. Meetings, fourth Friday of each month.

American Railway, Mechanical & Electrical Association. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice, 12 West 31st St., New York. Next annual meeting, New York, Dec. 4-7, 1906. Spring meeting, Indianapolis, Ind., May, 1907.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y. Next meeting, Detroit, Mich., third Wednesday, September, 1907.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, 60 Wall St., New York.

Association of Edison Illuminating Companies. Secretary, Geo. R. Stetson, New Bedford, Mass.

Association of Railway Telegraph Superintendets. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Atlantic City, N. J., June 19, 1907.

Association of Electric Lighting Engineers of New England. Secretary, Welles E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston third Wednesday in March.

California Independent Telephone Association. Secretary, P. T. Whittier, Spencer, Cal.

Canadian Electrical Association. Secretary, T. S. Young, Toronto, Ont.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, John F. Dostal, 405 17th St., Denver, Col. Next meeting, September, 1907.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, E. W. Poole, Bridgeport, Conn.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

ELECTRIC CLUB OF CLEVELAND. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Chas. J. Sutter, 1220 Pine St., St. Louis, Mo. Next meeting, St. Louis, Mo., Dec. 13, 1906.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary-Treasurer, Geo. H. Erich, 401 Monadnock Block, Chicago. Next annual meeting, Chicago, January, 1907.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederic P. Vose, Marquette Building, Chicago.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays each month.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, Wm. R. Stavely, Royal Insurance Building, Montreal, Can. Next annual meeting, January 14, 1907.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliot, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall Street, New York. Board of Directors meets second Friday of each month.

EMPIRE STATE GAS AND ELECTRICAL ASSOCIATION. Secretary, R. A. Davidson, 58 William St., New York. Next meeting, November, 1907.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, Dr. Arthur H. Elliot, 4 Irving Place, New York. Meetings in New York, second Friday of each month.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INDIANA ELECTRIC RAILWAY ASSOCIATION. Secretary, P. H. White, Indianapolis, Ind. Monthly meetings, second Tuesday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Norfolk, Va.

IOWA ELECTRICAL ASSOCIATION. Secretary, L. B. Spinney, Iowa State College, Ames, Ia. Next meeting, Clinton, Ia., April, 1907.

IOWA STREET AND INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Clinton, Ia., May, 1907.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Ia. Next meeting, Sioux City, Ia., March 12-14, 1907.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Topeka, Kan., October 16, 1907.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October each year.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Houck McHenry, Jefferson City, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next annual meeting, Chicago, second Thursday in June, 1907.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee Street, Utica, N. Y. Next meeting, New York City, July 17, 18 and 19, 1907.

NATIONAL-INTERSTATE TELEPHONE ASSOCIATION. Secretary, A. L. Tetu, Nashville, Tenn.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, W. C. L. Eglin, Philadelphia, Pa.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW ENGLAND ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty Street, New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y. Next meeting, Syracuse, N. Y., June, 1907.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, B. C. Adams, Madison, Wis.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, O.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Portsmouth, O. Next meeting, Columbus, O., last Thursday in April, 1907.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, F. W. Bullard, Cleveland, O.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Chas. Currie, Akron, O.

OLD TIME TELEGRAPHERS AND HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York. Next meeting, Niagara Falls, N. Y., 1907.

PACIFIC COAST ELECTRICAL TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 136 South Second Street, Philadelphia, Pa.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings second Saturday of each month.

SOUTH DAKOTA TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D. Next meeting, Sioux Falls, S. D., Jan. 9 and 10, 1907.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, E. B. Meginnis, Dallas, Tex.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, E. M. White, Box 345, Hartford, Conn.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, Canandaigua, N. Y.

UNDERWRITERS NATIONAL ELECTRIC ASSOCIATION. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby Street, Boston, Mass. Next meeting, March, 1907.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury Electric Light Company, Middlebury, Vt.

WESTERN SOCIETY OF ENGINEERS, Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Wednesday of each month, except January, July and August. Annual meeting first Tuesday after Jan. 1, each year.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOV. 20, 1906.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

836,088. LETTER FOR ELECTRIC SIGNS; Horace B. Camp, Akron, O. App. filed July 3, 1905. The letters of the sign are made of integral porcelain with the sockets formed directly thereon and provided with the necessary recesses for the attachment of metallic clips.

836,107. SECONDARY BATTERY; Louis H. Flanders, Wilkinsburg, Pa. App. filed Apr. 15, 1905. In a secondary battery, a container and plates or electrodes in combination with a spacing or insulating member encircling said electrodes and provided with a pointed retaining-lug.

836,121. MOLDING OR ELECTRIC WIRE CONDUCTOR: William H. G. Kirkpatrick, Philadelphia, Pa. App. filed May 5, 1905. The brackets for securing the molding to the ceiling are arranged to depend so as to allow the molding to be temporarily supported a few inches from the ceiling. In this way the circuit wires may be conveniently laid in place and the moldings afterward moved up into their permanent positions.

836,122. HIGH POTENTIAL INSULATOR: Fred M. Locke, Victor, N. Y. App. filed Mar. 23, 1903. The insulator is provided with a separate outside bell-shaped part and a central core. The central core receives the usual bolt and is formed so as to provide a large arcing space from the bell to the circuit wire.

836,151. DRY-CELL BATTERY; George L. Traver, Greenfield, Ind. App. filed Mar. 5, 1906. Relates to details of a dry battery having an electrolyte composed of manganese dioxide, sal-ammoniac and sulphuric acid.

836,153. SIGNALING SYSTEM FOR ELECTRIC RAILWAYS; Louis H. Thullen, Edgewood Park, Pa. App. filed June 9, 1906. Relates to block signal systems having insulated block sections which are separately energized by local batteries and in which the rails are also used as the return connection for the alternating-current power circuit. Has separate relays, one of which is responsive only to direct current and the other of which is responsive only to alternating currents.

836,155. ELECTRICAL CONDUCTOR AND JOINT THEREFOR; Frank J. Tone, Niagara Falls, N. Y. App. filed Nov. 11, 1905. A joint for electric conductors having between the surfaces to be connected a layer of compressed electrically-produced graphite; substantially as described.

836,177. ART OF PRODUCING PIGMENTS BY ELECTROLYSIS: Edwin D. Chaplin, Boston, Mass. App. filed Feb. 3, 1906.

836,202. TELEPHONE-RECEIVER SWITCH; James McMahon, Oakdale, Cal. App. filed July 24, 1905. A telephone-receiver switch comprising a case, a magnet therein, a plurality of flexible blades between the legs of the magnet, insulating material between the blades and the legs of the magnet, respectively, part of said points being normally in contact and part of them out of contact, and means upon the exterior of the case for automatically separating the closed contacts and closing the separated ones.

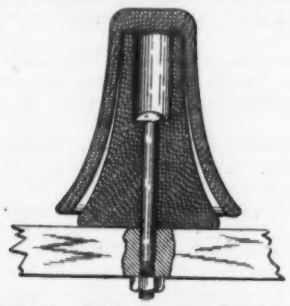
836,204. TELEPHONE SYSTEM; Frederick R. Parker, Lafayette, Ind. App. filed July 27, 1903. Relates to the details of a cord circuit for a telephone exchange system.

836,243. ELECTRICALLY OPERATED RAILWAY SIGNAL AND

GATE; James G. O. Combs and Isaac D. Combs, Harold, Mo. App. filed Apr. 20, 1906. Specially constructed depressible tappets are positioned on the usual ties adjacent to the rail so as to be depressed by the passage of a train. These close circuits to special motors which are arranged to operate the gates of the crossing.

836,261. MANUFACTURING ELECTRODES FOR ELECTRICAL ACCUMULATORS BY MEANS OF CONTINUALLY WORKING MACHINES; Ernst W. Jungner, Kneippbaden, Sweden. App. filed Sept. 11, 1905. The method of making accumulator-electrodes, which comprises feeding continuous metallic ribbons toward each other, perforating the ribbons, then feeding an active mass between said ribbons and finally uniting the ribbons and severing the electrodes thus formed.

836,279. MEANS FOR CONTROLLING THE SUPPLY OF ELECTRIC CURRENTS; Friedrich W. Schneider, Frankfort-on-the-Main-Bockenheim, Germany. App. filed Dec. 17, 1903. A device for preventing



836,122.—High Potential Insulator.

a purchaser from using too much current when there is no meter in the circuit. A resistance wire is included which becomes heated by an excess current so as to intermittently open and close the circuit.

836,280. SWITCH FOR ELECTRIC CIRCUITS; Burtin G. Seavey and Walter G. Millen, Keene, N. H. App. filed Sept. 22, 1905. A switch box connection by which the regular circuit can be interrupted and a short circuit conveniently produced for the purposes of testing out grounds and breaks.

836,282. ELECTRIC HEATING PAD; Luella W. Shellhamer, Los Angeles, Cal. App. filed Apr. 2, 1906. A pad or blanket having an asbestos-lined interior, and a resistance wire led in a sinuous or zigzag path throughout the same so as to warm the blanket.

836,295. DEVICE FOR LIGHTING BY ELECTRICITY REVERSED GAS BURNERS; Paul Benard, Epernay, France. App. filed Nov. 21, 1905. Relates to inverted mantel gas burners and has a platinum coil which is arranged to be heated by an electric current. Provides means for shielding the platinum wire from the injurious gases.

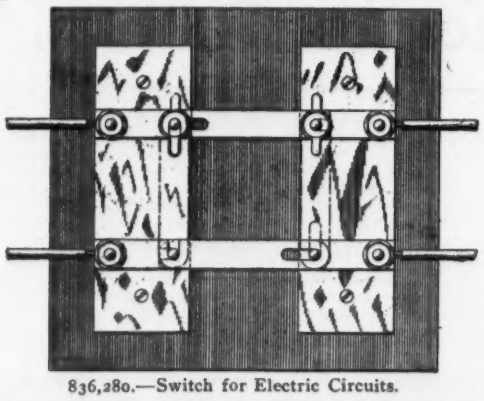
836,307. CIRCUIT CONTROLLING KEYBOARD APPARATUS; Patrick B. Delany, South Orange, N. J. A keyboard telegraph transmitter having sliding springs which move over spaced contacts, and having a continuous revolving pinion into contact with which are depressed rack extensions from said springs.

836,314. CHARGING SYSTEM FOR STORAGE CELLS OR BATTERIES; Jacob De S. Freund, Edgewood Park, Pa. App. filed June 10, 1905. Relates to charging systems for storage cells or batteries and particularly to an automatic switch for use in such systems especially where the cells are in multiple.

836,352. SWITCH BOX; Charles E. Youmans, Yonkers, N. Y. App. filed June 13, 1904. An ordinary socket switch is enclosed in a protecting casing and the operating shaft passes through a specially constructed stuffing box having a conical plug so as to exclude moisture.

836,355. PRODUCTION OF GRAPHITE; Edward G. Acheson, Stamford Township, Ontario, Canada. App. filed Sept. 22, 1906. The method of making soft unctuous and non-coalescing graphite, which consists in heating in an electric furnace, a charge comprising, essentially, carbonaceous material and carbid-forming material, said carbid-forming material being in excess of twenty per cent. by weight of the charge, but in less than the theoretical proportion required for the production of a carbid.

836,359. METHOD AND APPARATUS FOR TESTING ALTERNATORS; Bernard A. Behrend, Norwood, O. App. filed July 11, 1904. The method of operating alternating-current machines for testing purposes, which consists in dividing the field into sections, wound to act as a motor and a generator respectively, and using different exciting-currents for the motor-section and the generator-section of the field-winding so that the resultant magnetic field produced by the inter-



836,280.—Switch for Electric Circuits.

action of the impressed and induced fields is the same for each pair of field poles.

836,377. AUTOMATIC ALARM; Ira Filson, Springfield, O. App. filed Feb. 8, 1905. A form of damper placed in the chimney is normally held open by the gases, but in case of failure of flow the damper moves into a position to close an alarm circuit.

836,380. PROCESS OF TREATING ORES; Wilbur A. Hendryx, Los Angeles, Cal. App. filed Sept. 20, 1904. The process of treating auriferous and argentiferous ores, which consists in mixing the ore with a cyanid solution, continuously aerating the mixture by lifting portions and distributing them in contact with the atmosphere and simultaneously passing an electric current through the body of the mixture to deposit the metals in solution.

836,396. ELECTRIC OUTLET INSULATOR; John E. Moore, Davenport, Ia. App. filed Oct. 27, 1902. A form of metal casing having curved passages for the circuit wires of a chandelier and a central passage for the gas pipe.

836,407. TELEPHONE-ATTACHMENT; Joseph Silverman, San Francisco, Cal. App. filed Mar. 5, 1906. The combination with a telephone-hook, of a vertically and laterally adjustable finger-support, a finger pivoted on said support, a spring operating on the finger to hold down the hook, and stop means limiting the pivotal movement of the finger.

836,427. MOTOR STARTING SWITCH; Thorsten von Zweigbergk, Preston, England. App. filed May 21, 1906. The resistance arm is moved over the contacts by a form of Geneva stop motion which precludes too rapid movement, but which allows the switch arm to return in case of no voltage.

836,454. TELEGRAPH KEY; Edward M. McConihay, Lewiston, W. Va. App. filed Dec. 29, 1905. A plate is pivoted so as to project beneath the button of an ordinary transmitting key, and this plate is arranged to normally close the circuit of the key except when held raised during the manual operation of the key.

836,468. CAP FOR ELECTRICAL ATTACHMENT PLUGS AND THE LIKE; Frank E. Seeley, Bridgeport, Conn. App. filed Apr. 23, 1906. The insulating bushing is attached to the sheet metal cap by a screw and slot in the usual manner, but a pair of protuberances are provided adjacent to the usual screw so as to prevent the parts from becoming dislodged.

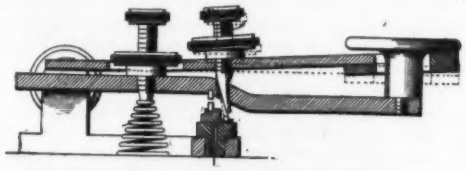
836,480. DRY-BATTERY CELL; John W. Brown, Cleveland, O. App. filed Sept. 14, 1906. A dry battery having its parts so disposed that the total internal resistance between the two binding-posts through the electrodes and electrolyte will be substantially the same along all paths of the current.

836,482. CUT-OUT; Clifton L. Bundy and Albert H. Manwaring, Philadelphia, Pa. App. filed June 21, 1904. The arc lamp is suspended through an intermediate box or casing having a plug switch which can be operated by the lamp trimmer to open the circuit when the lamp is being attended to.

836,489. TESTING SYSTEM FOR TELEPHONE-LINES; William W. Dean, Chicago, Ill. App. filed June 29, 1903. In a telephone system, the combination with an operator's connecting cord and plug, of a testing device normally connected with the tip-strand of said cord, and a switch operated during testing to open said strand in the rear of the connection of said device and to place the operator's telephone set in condition to receive impulses from said device, substantially as described.

836,508. MAIN LINE SOUNDER; Joseph H. Kidny, Lisle, Mo. App. filed Feb. 2, 1906. The ordinary relay of a telegraph outfit has a sound box permanently attached thereto and a lever connection for impressing the vibrations on the sound box so as to amplify the sound.

836,514. TELEPHONE CORD-CIRCUIT; Albion D. T. Libby, Chicago,



836,454.—Telegraph Key.

Ill. App. filed Sept. 3, 1904. Relates to a party line system having magneto generators at the sub-stations for signaling purposes.

836,531. MEANS FOR RECEIVING INTELLIGENCE COMMUNICATED BY ELECTRIC WAVES; Greenleaf W. Pickard, Amesbury, Mass. App. filed Aug. 20, 1906. As an element of a means for receiving intelligence communicated by electric waves, the substance silicon, substantially as and for the purpose described.

836,558. APPARATUS FOR WORKING FUSED SILICA OR THE LIKE; James F. Bottomley, Wallsend, and Arthur Paget, North Cray, England. App. filed Feb. 28, 1906. In apparatus for working fused silica or the like, a furnace, terminals therein, and a resistance-core so connected thereto as to permit of the removal of the core from the fused mass, so that the fused mass can be removed from the furnace during plasticity, substantially as and for the purposes set forth.

836,576. STATIC DISCHARGER; William L. Hardwicke, Richmond, Va. App. filed Apr. 3, 1905. A bar is provided with a plurality of downwardly extending needles in proximity to the sheet being delivered from a printing press so as to dissipate the electricity therefrom.

836,581. MEANS FOR ELIMINATING OR REDUCING THE INFLUENCE OF DISTURBING-CURRENTS ON THE TELEPHONE-CIRCUITS; Charles M. Jacobs, Reading, England. App. filed Apr. 27, 1906. Means for eliminating or reducing the influence of disturbing currents on a telephone-receiver in a telephone-circuit, consisting of a phonopore-winding on the receiver, the phonopore-winding and the receiver-winding being one winding.

836,611. REGULATING DEVICE FOR TELEPHONE RELAYS AND TRANSMITTERS; Herbert E. Shreeve, Newton, Mass. App. filed Oct. 26, 1905. The combination with a variable-resistance telephone transmitting device, of a thermal resistance and current-regulator therefor in circuit therewith, substantially as set forth.

836,612. REGULATING DEVICE FOR TELEPHONE RELAYS AND TRANSMITTERS; Herbert E. Shreeve, Newton, Mass. App. filed Oct. 26, 1905. Has a granular carbon button and a magnet having two windings, one of which is in circuit with the transmitting line and the other of which is in circuit with the repeating circuit.

836,659. INDUCTION COIL APPARATUS; Ernest C. Wilcox, Meriden, Conn. App. filed Apr. 14, 1906. Relates to various features of an induction coil for automobiles, including the construction of the vibrator and the contacts by which the primary circuit is completed.

12,560. TELEPHONE-EXCHANGE SYSTEM; William M. Davis, Seattle, Wash. App. filed Oct. 30, 1903. Shows a circuit for a telephone system having magnetic visual signals.

12,561. ELECTRIC-TUBE LIGHTING; Daniel M. Moore, Newark, N. J. App. filed Nov. 19, 1903. In a high-potential system of electric lighting, an electric lamp consisting of lengths of glass tubing joined together and forming substantially all of the high-potential circuit, said lamp having terminal sections provided with suitable conducting-electrodes connected with a source of energy proper for rendering the gaseous contents of the tube luminous.

12,565. SEMI-AUTOMATIC TELEPHONE-EXCHANGE SYSTEM; Arthur T. M. Thomson, London, England. App. filed May 2, 1906. Provides means for indicating to a called operator the signal which has been set by a subscriber.